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# BECKMAN

## HAND-HELD DIGITAL MULTIMETERS SERIES 300, SERIES 3000, AND HD SERIES

# SERVICE MANUAL

# BECKMAN

# HAND-HELD DIGITAL MULTIMETERS

# SERIES 300, SERIES 3000,

# AND HD SERIES

## SERVICE MANUAL

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SECTION ONE

# GENERAL INFORMATION

## 1 INTRODUCTION

The Series 300, Series 3000, and Series HD Digital Multimeters are a group of portable 3½-digit multimeters designed for use by the engineer, technician, or hobbyist. Each of the wide variety of functions and ranges available is quickly and easily selected with the turn of a single selector switch. The portability and accuracy of these instruments make them equally well suited for design engineering, production testing, field servicing, and industrial maintenance applications

## 2 SPECIFICATIONS

Accuracies are ±(% of reading + no. of digits). Guaranteed for one year, 25°C ±5°C

| **DC Voltage** | **HD-100** | **HD-110** |
|---|---|---|
| Ranges | ±200mV, 2V, 20V, 200V, 1500V | |
| Resolution | 100μV on 200mV range | |
| Accuracy | 0.25% rdg. + 1 | |
| Input Impedance | 22MΩ, all ranges | |
| Normal Mode Rejection | >60 dB above 49Hz | |
| Common Mode Rejection | >140 dB up to 1500Vdc | |
| Response Time | Less than 1 second | |
| Overvoltage Protection | 1500Vdc or peak ac, any range | |
| **AC Voltage** | **HD-100** | **HD-110** |
| Ranges | 200mV, 2V, 20V, 200V, 1000V | |
| Resolution | 100μV on 200mV range | |
| Accuracy—45Hz- 2kHz<br>2Hz- 5kHz<br>5Hz-10kHz | 0.75% rdg. + 3<br>1.50% rdg. + 5<br>2.50% rdg. + 9 | |
| Conversion Type | Average sensing—RMS calibrated sine wave | |
| Input Impedance | 2.2MΩ shunted by <75pF | |
| Response Time | Less than 2 seconds | |
| Overvoltage Protection | 1000Vrms/1500V peak ac or 250Vdc<br>(5 sec. max above 450Vrms, 200mV range) | |
| **Resistance** | **HD-100** | **HD-110** |
| Ranges | 200Ω, 2KΩ, 20KΩ, 200KΩ, 2MΩ, 20MΩ | |
| Resolution | 0.1Ω on 200Ω range | |
| Accuracy—200Ω to 2MΩ Ranges | 0.5% rdg. + 1 | |
| 20MΩ Range | 1.5% rdg. + 1 | |
| Maximum Open Circuit Voltage | 500mV | |
| Maximum In-Range Voltage | 250mV | |
| Maximum Test Current | 2.5mA | |
| Response Time | Less than 1 sec., except 20MΩ range, less than 4 sec. | |
| Overload Protection | 600Vdc or rms ac on any range | |
| **Insta-Ohms Continuity Function** | **HD-100** | **HD-110** |
| Response Time | <100 milliseconds | |
| **Diode Test** | **HD-100** | **HD-110** |
| Range | 0 to 2V | |
| Resolution | 1mV | |
| Accuracy | 0.25% rdg. + 2 | |

| Test Current | 2mA, ±10% | |
|---|---|---|
| Response Time | Less than 1 second | |
| Overload Protection | 600Vdc or rms ac on any range | |
| **DC Current** | **HD-100** | **HD-110** |
| Ranges | 200μA, 2mA, 20mA, 200mA, 2A | 200μA, 2mA, 20mA, 200mA, 2A, 10A |
| Resolution | 100nA on 200μA range | |
| Accuracy—200μA to 2A Range | 0.75% rdg. + 1 | |
| Accuracy—10A Range | Not applicable | 1.5% rdg. + 1 |
| Response Time | Less than 1 second | |
| Voltage Burden | 250mV max. at full scale except 2A range 700mV | 200mV max. at full scale except 2A range 700mV, 10A range 250mV |
| Overcurrent Protection (A Input) | 2 amps/600V (fused) | |
| Overcurrent Protection (10A Input) | Not applicable | Up to 20 amps for 30 seconds (unfused) |
| **AC Current** | **HD-100** | **HD-110** |
| Ranges | 200μA, 2mA, 20mA, 200mA, 2A | 200μA, 2mA, 20mA, 200mA, 2A, 10A |
| Resolution | 100nA on 200μA range | |
| Accuracy—200μA to 2A Range—45Hz-2kHz | 1.5% rdg. + 3 | |
| Accuracy—10A Range—45Hz to 400Hz | Not applicable | 2.0% rdg. + 3 |
| Conversion Type | Average sensing | |
| Response Time | Less than 2 seconds | |
| Voltage Burden | 250mV max. at full scale except 2A range 700mV | 200mV max. at full scale except 2A range 700mV, 10A range 250mV |
| Overcurrent Protection (A Input) | 2 amps/600V (fused) | |
| Overcurrent Protection (10A Input) | Not applicable | Up to 20 amps for 30 seconds (unfused) |
| **General** | **HD-100** | **HD-110** |
| Operating Temp. | 0°C to +50°C | |
| Storage Temp. | −40°C to +65°C, battery removed | |
| Max. Common Mode V | 1500Vdc or peak ac | |
| Display | 3½-digit LCD (1999 max. count) | |

| | |
|---|---|
| Power | Single std. 9V battery, NEDA 1604 |
| Battery Life | Alkaline: 2000 continuous hours typical—<br>Zinc carbon: 1600 continuous hours typical |
| Low Battery Ind. | Decimal point blinks during last 200 hours of battery life |
| Shock & Vibration | Meets MIL-T-28800 specifications |
| Rel. Humidity | 0-80%, 0°C to 35°C; 0-70%, 35°C to 50°C |
| Tempco | Less than 15% of applicable accuracy spec. per °C (0°C to 20°C, 30°C to 50°C) |
| Dimensions | 7.2 in. L × 3.9 in. W × 2.0 in. H |
| Case Material | High impact, fire retardant, plastic |
| Weight | 18 oz. (510g) including battery |
| Calibration | Accuracy specifications guaranteed for one year |
| Calibration Adj. | One |
| Measurement Rate | Four measurements per second, nominal |

| **DC Voltage** | **3000** | **3010** | **3010UL** | **3020/3020B** | **RMS 3030** |
|---|---|---|---|---|---|
| Ranges | ±200mV, 2V, 20V, 200V, 1500V | | ±200mV, 2V, 20V, 200V, 750V | ±200mV, 2V, 20V, 200V, 1500V | |
| Resolution | 100μV on 200mV range | | | | |
| Accuracy | 0.5% rdg. ±1 digit | 0.25% rdg. ±1 digit | | 0.1% rdg. ±1 digit | |
| Input Impedance | 22MΩ all ranges | | | | |
| Normal Mode Rejection | >60dB above 49Hz | | | | |
| Common Mode Rejection | >140dB up to 1500Vdc | | >140dB up to 750Vdc | >140dB up to 1500Vdc | |
| Response Time | Less than 1 second | | | | |
| Overvoltage Protection | 1500Vdc or peak ac any range | | 750Vdc or peak ac, any range | 1500Vdc or peak ac, any range | |
| **AC Voltage** | **3000** | **3010** | **3010UL** | **3020/3020B** | **RMS 3030** |
| Ranges | 200mV, 2V, 20V, 200V, 1000V | | 200mV, 2V, 20V, 200V, 500V | 200mV, 2V, 20V, 200V, 1000V | |
| Resolution | 100μV on 200mV range | | | | |
| Accuracy<br>45Hz-2kHz<br>2kHz-5kHz<br>5kHz-10kHz<br>10kHz-20kHz | <br>1.5% rdg. ±4 digits<br>2.0% rdg. ±5 digits<br>3.0% rdg. ±9 digits<br>Not specified | <br>0.75% rdg. ±3 digits<br>1.5% rdg. ±5 digits<br>2.5% rdg. ±9 digits<br>Not specified | | <br>0.6% rdg. ±3 digits<br>1% rdg. ±5 digits<br>2.0% rdg. ±9 digits<br>Not specified | <br>0.6% rdg. ±4 digits<br>1% rdg. ±5 digits<br>1.5% rdg. ±6 digits<br>2% rdg. ±8 digits |
| Conversion Type | Average sensing—RMS calibrated sine wave | | | | True RMS (ac + dc) |
| Input Impedance | 2.2MΩ shunted by <75pF | | | | |
| Response Time | Less than 2 seconds (on RMS 3030, above 10% of full scale) | | | | |
| Overvoltage Protection | 1000Vrms/1500V peak or 250Vdc (5 sec. max. above 450Vrms, 200mV range) | | 500Vrms/750V peak or 250Vdc (5 sec. max. above 225Vrms, 200mV range) | 1000Vrms/1500V peak or 250Vdc (5 sec. max. above 450Vrms, 200mV range) | |
| Crest Factor* | Not applicable | | | | 1:1 to 5:1 |
| **Resistance** | **3000** | **3010** | **3010UL** | **3020/3020B** | **RMS 3030** |
| Ranges | 200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ, 20MΩ | | | | |
| Resolution | 0.1Ω on 200Ω range | | | | |
| Accuracy<br>200Ω to 2MΩ Ranges<br>20MΩ Range | <br>0.75% rdg. ±1 digit<br>1.5% rdg. ±1 digit | <br>0.5% rdg. ±1 digit<br>1.5% rdg. ±1 digit | | <br>0.2% rdg. ±1 digit<br>1.0% rdg. ±1 digit | |
| Maximum Open Circuit Voltage | 500mV | | | | |
| Maximum In-Range Voltage | 250mV | | | | |
| Maximum Test Current | 2.5mA | | | | |
| Response Time | Less than 1 second, except 20MΩ range, less than 4 seconds | | | | |
| Overload Protection | 500Vdc or rms ac at any range | | | | |
| **Insta-Ohms Continuity Function** | **3000** | **3010** | **3010UL** | **3020/3020B** | **RMS 3030** |
| Response Time | Not applicable | <100 milliseconds | | | |
| **Diode Test** | **3000** | **3010** | **3010UL** | **3020/3020B** | **RMS 3030** |
| Range | 0 to 2V | | | | |
| Resolution | 1mV | | | | |
| Accuracy | 0.5% rdg. ±2 digits | 0.25% rdg. ±2 digits | | 0.1% rdg. ±2 digits | |
| Test Current | 2mA, ±10% | | | | |
| Response Time | Less than 1 second | | | | |
| Overload Protection | 500Vdc or rms | | | | |

*Crest Factor = $\frac{\text{Peak Voltage}}{\text{RMS Voltage}}$

| **DC Current** | **3000** | **3010** | **3010UL** | **3020/3020B** | **RMS 3030** |
|---|---|---|---|---|---|
| Ranges | 200μA, 2mA, 20mA, 200mA, 2A | 200μA, 2mA, 20mA, 200mA, 2A, 10A | | | |
| Resolution | 100μA on 200μA range | | | | |
| Accuracy<br>200μA to 2A Ranges | 1.0% rdg. ±1 digit | 0.75% rdg. ±1 digit | | 0.35% rdg. ±1 digit | |
| 10A Range | Not available | 1.5% rdg. ±1 digit | | 1.0% rdg. ±1 digit | |
| Response Time | Less than 1 second | | | | |
| Voltage Burden | 200A to 200mA ranges: 250mV maximum at full scale.<br>2A and 10A ranges: 700mV maximum at full scale. | | | | |
| Overcurrent Protection (A Input) | 2 amps/600V (fused) | | | | |
| Overcurrent Protection (10A Input) | Up to 20 amps for 30 seconds (unfused) | | | | |
| **AC Current** | **3000** | **3010** | **3010UL** | **3020/3020B** | **RMS 3030** |
| Ranges | 200μA, 2mA, 20mA, 200mA, 2A | 200μA, 2mA, 20mA, 200mA, 2A, 10A | | | |
| Resolution | μA on 200μA range | | | | |
| Accuracy<br>45Hz-2kHz (except 10A) | 2.0% rdg. ±4 digits | 1.5% rdg. ±3 digits | | 0.9% rdg. ±3 digits | |
| 2kHz-5kHz (except 2A and 10A ranges) | Not specified | | | | 1.5% rdg. ±3 digits |
| 45Hz-400Hz (10A range) | Not available | 2.0% rdg. ±3 digits | | 1.5% rdg. ±3 digits | |
| Conversion Type | Average sensing | | | | True RMS (ac + dc) |
| Response Time | Less than 2 seconds (on RMS 3030, above 10% of full scale) | | | | |
| Voltage Burden | 200μA to 200mA ranges: 250mV maximum at full scale<br>2A and 10A ranges: 700mV maximum at full scale | | | | |
| Overcurrent Protection (A Input) | 2 amps/600V (fused) | | | | |
| Overcurrent Protection (10A Input) | Not available | Up to 20 amps for 30 seconds (unfused) | | | |
| **General** | **3000** | **3010** | **3010UL** | **3020/3020B** | **RMS 3030** |
| Operating Temperature | 0°C to +50°C | | | | |
| Storage Temperature | −40°C to +65°C, battery removed | | | | |
| Maximum Common Mode Voltage | 1500Vdc or peak ac | | | | |
| Display | 3½-digit LCD (1999 max. count) | | | | |
| Power | Single standard 9V battery, NEDA 1604 | | | | |
| Battery Life | Alkaline: 2000 continous hours typical. Zinc-carbon: 1600 continuous hours typical | | | | |
| Low Battery Indicator | Decimal point blinks during the last 200 hours of battery life | | | | |
| Shock and Vibration | Meets MIL-T-28800 specifications | | | | |
| Relative Humidity | 0-80%, 0°C to 35°C; 0-70%, 35°C to 50°C | | | | |
| Temperature Coefficient | Less than 15% of applicable accuracy spec. per °C (0°C to 20°C, 30°C to 50°C) | | | | |
| Dimensions | 6.85 in. L × 3.65 in. W × 1.8 in. H (17.4cm L × 9.3cm W × 4.6cm H) | | | | |
| Case Material | High impact, fire retardant, ABS plastic | | | | |
| Weight | 16 oz. (453g) including battery | | | | |
| Calibration | Accuracy specifications guaranteed for 1 year | | | | |
| Calibration Adjustments | One adjustment for 3000, 3010, 3010UL, and 3020/3020B. Four adjustments for RMS 3030. | | | | |
| Measurement Rate | 4 measurements per second, nominal | | | | |

SECTION TWO

# MAINTENANCE AND SERVICING

## 1 GENERAL

This section contains procedures for calibration, maintenance, and repair of the Series 300, Series 3000, and HD Series Multimeters. Also included are procedures for Multimeter disassembly, component replacement, Function/Range Switch disassembly and check procedures. If you are uncertain about what maintenance and service to perform, refer to Section Four TROUBLESHOOTING.

## 2 SERVICING POLICY

### ONE YEAR LIMITED WARRANTY POLICY ON NEW INSTRUMENTS

The Beckman Digital Multimeter is warranted in its entirety against any defects of material or workmanship which develop for any reason whatsoever, except abuse, within a period of one (1) year following the date of purchase of the Multimeter by the original purchaser. This warranty is extended by Beckman Instruments, Inc. (Beckman), only to the original purchaser or original user of the Multimeter, who must, as a CONDITION PRECEDENT TO WARRANTY COVERAGE AND PERFORMANCE THEREUNDER BY BECKMAN, complete and return the Warranty Registration Card, received on purchase of the Multimeter.

In the event a defect develops during the warranty period, Beckman will, at Beckman's election, repair or replace the Multimeter with a new or reconditioned model of equivalent quality. To obtain performance of any obligation of Beckman under the warranty, the original purchaser or original user must return the defective Multimeter, postage prepaid, along with a handling charge of $3.00 (prices subject to change), to:

Beckman Instruments, Inc.
630 Puente Street
Brea, CA 92621
Attention: Customer Service

or to any other authorized Beckman Service Center.

In the event of replacement with a new or reconditioned model, the replacement unit will continue the warranty period of the original Multimeter. Replacement units will be returned by air, typically with only one (1) working day turnaround at the Service Center.

******

ANY IMPLIED WARRANTIES ARISING OUT OF THE SALE OF THE MULTIMETER, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO THE ABOVE STATED ONE (1) YEAR PERIOD. BECKMAN SHALL NOT BE LIABLE FOR LOSS OF USE OF THE MULTIMETER OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, OR ECONOMIC LOSS OR FOR ANY CLAIM OR CLAIMS FOR SUCH DAMAGE, EXPENSES OR ECONOMIC LOSS.

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Some states do not allow limitations on how long implied warranties last or the exclusion or limitations of incidental or consequential damages, so the above limitations or exclusions may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

## 2.1 After-Warranty Repair or Exchange Service

After-warranty service is provided by Beckman in two ways. You may elect to have your instrument repaired at an authorized Beckman repair facility, or you can exchange your defective out-of-warranty instrument for a reconditioned instrument at a flat rate contained on Beckman's current price list. The replacement unit carries a three (3) month limited warranty. Contact any authorized Beckman Distributor or Beckman Instruments, Inc., for the current non-warranty replacement rates and instructions for shipping the instrument.

## 2.2 Calibration Service

Each Beckman Multimeter should be calibrated at least once a year or after it is repaired. A procedure to accomplish this is contained in this section. If you do not have the necessary equipment specified to accomplish calibration, this service

can be performed by an authorized Beckman Service Center. If you wish to take advantage of this service, contact any authorized Beckman distributor, repair facility, or Beckman Instruments, Inc., for current calibration rates and instructions for shipping the instrument.

## 3 SERVICING PROCEDURES FOR HAND-HELD METERS

### 3.1 Multimeter Disassembly Procedure

Before performing any of the Multimeter servicing, it is necessary to disassemble the instrument, remove four screws, and carefully lift off back cover.

After performing the service or inspection, reassemble the instrument, being careful to hold shield so that it goes inside the housing without being bent or crushed. Improper reassembly can damage foil shield, resulting in improper operation of the multimeter.

### 3.2 Battery Replacement

> CAUTION: TO PREVENT ELECTRICAL SHOCK HAZARD, TURN OFF MULTIMETER AND DISCONNECT TEST LEADS BEFORE REMOVING BACK COVER.

After disconnecting test leads and turning off Multimeter, remove back cover by removing four screws, then lift off back cover.

> CAUTION: FAILURE TO TURN OFF INSTRUMENT BEFORE INSTALLING BATTERY COULD RESULT IN DAMAGE TO BATTERY IF IT IS CONNECTED INCORRECTLY TO TERMINALS.

3.2.1
Disconnect battery from instrument and replace with new standard 9-volt transistor battery.

3.2.2
Replace back cover and secure with four screws.

WARNING > DO NOT OPERATE MULTIMETER WITH BACK COVER REMOVED (EXCEPT DURING CALIBRATION).

## 3.3 Fuse Replacement

CAUTION: TO PREVENT ELECTRICAL SHOCK HAZARD, TURN OFF MULTIMETER AND DISCONNECT TEST LEADS BEFORE REMOVING BACK COVER.

After disconnecting test leads and turning off Multimeter, remove back cover.

3.3.1
The fuse is located in the upper half of the instrument on the older models and in the lower half on the latest models.

3.3.2
Remove the old fuse and replace with good fuse. If spare fuse is missing, replace it also.

CAUTION: TO PREVENT FIRE, USE ONLY TYPE AGX 2A/600V FUSE.

3.3.3
Replace back cover and secure with four screws.

## 3.4 Multiprocessor Chip and Liquid Crystal Display Replacement

If you have determined that either the multiprocessor chip or the display needs to be replaced, this can be accomplished by following the procedure in Figure 1 and Figure 3.

## 3.5 Elastomer Strips Cleaning and Replacement Procedure

If display segments do not function or if a corrective action step in the troubleshooting guide instructs you to inspect or replace an elastomer strip, access to these connectors can be gained by performing the procedure in Figure 2. Strips can be cleaned by dusting with a short-bristle camel's hair brush. If grease or fingerprint contamination is suspected, the strip may be washed in

clean alcohol and air-dried. Do not wipe off with fibrous material as excessive lint can cause poor connections.

3.6 Small Circuit Board Inspection and Replacement Procedure

Inspecting the small circuit board to determine if the Function/Range Switch is working properly or replacement of the small circuit board because of faulty operation requires the following procedure.

3.6.1
After removing back cover of Multimeter, remove battery and battery case. Disconnect female input connectors with needle-nosed pliers on older models. HD Series Models and newer models will have two extra screws which need to be removed before separating module from front case. Newer models do not have female connectors, but instead input jacks directly soldered to the board.

3.6.2
Remove two No. 6 screws from rear of small circuit board.

3.6.3
Grasp outer edge of circuit boards and gently separate them from the front cover assembly. On HD models, remove the heavy-duty shock mount.

CAUTION: CIRCUIT BOARDS ARE STATIC SENSITIVE--HANDLE BY EDGES ONLY

3.6.4
With electronics assembly facing downward, squeeze together the prongs holding the retainer bar. Apply light pressure downward to free retainer from prongs. Repeat with the second set of prongs.

3.6.5
Again squeeze prongs if necessary, and carefully remove multiprocessor chip.

CAUTION: Multiprocessor chip is an extremely sensitive CMOS device. Handle chip with approved procedure (using bracelet, etc.).

Note: If you are replacing only the multiprocessor chip, proceed to Step 3.6.4. If replacing the display, go on to Steps 3.6.2, 3.6.3 and then 3.6.9.

FIGURE 1

3.6.6
Using forceps, carefully remove the two elastomer (zebra) strips from the multiprocessor chip holder.

CAUTION: DO NOT PINCH ZEBRA STRIPS OR TOUCH THEM WITH YOUR FINGERS. THEY CAN EASILY BECOME CRUSHED OR CONTAMINATED, THUS IMPAIRING CONDUCTIVITY.

FIGURE 2

3.6.7
Once again, squeeze prongs together and remove the display face and chip retainer from the circuit board.

3.6.8
Using caution, remove zebra strip from top of display retaining assembly.

3.6.9
To remove liquid crystal display, insert a small flat blade screwdriver between the retainer and the faceplate. Gently pry along the edge to unlatch all tabs, then remove retainer.

FIGURE 3

3.6.10
Remove LCD display, taking care to touch only the edges of the glass.

3.6.11
Place new display face-down into faceplate. Notice which edge of the LCD has stripes in the glass--this is the connector edge. Align the clear retainer over the rear of the display by matching the slot for the zebra strip with the connector edge of the LCD. Snap retainer into place, making sure that all tabs are fully engaged.

3.6.12
Replace zebra strip in slot at edge of retainer.

3.6.13
Position display assembly with zebra strip toward top of circuit board. Insert display assembly prongs into two holes on large circuit board. Snap together by applying gentle pressure and squeezing prongs together.

3.6.14
Place multiprocessor chip holder onto tabs. Make sure the indexing boss on right-hand underside of holder is inserted into index hole in the circuit board. Refer to Figure 2.

3.6.15
Insert two cleaned or new zebra strips into slots on chip retainer. (Reference "Elastomer Strips Cleaning Procedure" documented earlier in this section).

CAUTION: AVOID PINCHING ZEBRA STRIPS OR TOUCHING THEM WITH YOUR FINGERS.

3.6.16
Carefully place multiprocessor chip onto holder, gold connector side toward the circuit board. Align notch on side of chip with tab on side of chip holder.

3.6.17
Install chip retainer over chip and two prongs. Press downward with firm, even pressure until prongs are spread outward, holding retainer in place.

3.6.18
Insert electronics assembly into front cover. It may be necessary to turn the Function/Range knob on the front of the meter so that its shaft will align with the opening in the cam on the circuit board.

3.6.19
Insert two screws into back of circuit board assembly and tighten.

3.6.20
On older models, push female input circuit board connectors onto pins protruding from small circuit board. Be sure that these connectors fit snugly. Position leads so they will not be pinched by battery pack or between housings.

3.6.21
Reinstall battery into battery pack and connect plug. Place battery pack onto mounting slots provided. Route leads so they will not be pinched or contact input terminals.

3.6.22
Reassemble Multimeter.

3.7 Removal, Replacement, and Inspection Procedure for Electronics Assembly

3.7.1
Remove electronics assembly from Multimeter housing as described in Step 3.6.2.

3.7.2
Place electronics assembly on a flat surface with display facing upward. Remove two screws.

3.7.3
Holding circuit boards by outer edges, gently pull the two boards apart.

CAUTION: DAMAGE TO FUNCTION/RANGE SWITCH MAY RESULT IF CIRCUIT BOARDS ARE NOT PULLED STRAIGHT APART AS SHOWN.

3.7.4
Carefully remove switch cam from circuit board and remove detent spring from switch block.

3.7.5
Disassembly is now complete and Multimeter is exposed for inspection, repair, or replacement of parts. After these are completed, proceed to Step 3.7.6 for reassembly.

3.7.6
Carefully engage cam onto large circuit board assembly. T-slotted hub of cam should fit downward into hole.

> CAUTION: DO NOT ENGAGE CAM AT AN ANGLE AS DAMAGE TO DELICATE SWITCH CONTACTS COULD OCCUR.

3.7.7
Insert detent spring into slot beside cam, with the protrusion facing toward the cam. The detent spring may be mounted on either side. See Figure 4.

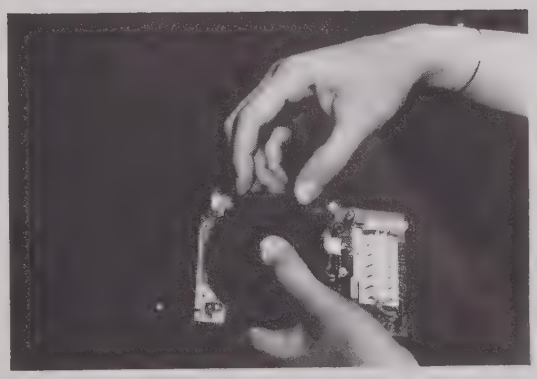


FIGURE 4

3.7.8
Engage connector on bottom edge of circuit boards and gently press the two circuit boards together. Make sure that hub of cam fits into place on the small circuit board, and that the detent spring and two mounting brackets all fit well together.

3.7.9
When two circuit boards are back together, insert two screws in front of assembly and tighten. Reassemble entire meter, using procedure described in Step 3.6.18.

## 3.8 Calibration Procedures

To maintain the accuracy specification of the Multimeter, it is important that the Multimeter be calibrated at least once a year and every time it is repaired. The test equipment necessary to accomplish this procedure is described below:

| INSTRUMENT | CHARACTERISTICS | RECOMMENDED MODELS |
|---|---|---|
| DC Calibrator | Voltage Range: 0 to 1000Vdc<br>Accuracy: ±0.025% | Rotek 600 or Equivalent |
| AC Calibrator | Voltage Range: 0 to 110Vac<br>Frequency Range: 400Hz to 20kHz<br>Accuracy: ±0.5% at 400Hz<br>±0.5% at 20kHz | Rotek 600, 745A or Equivalent |

### 3.8.1 DC Calibration

1. Perform calibration at ambient temperature of 25 ±2°C and relative humidity of 80% or less.

   Note: ALLOW INSTRUMENT TO STABILIZE AT THIS TEMPERATURE FOR AT LEAST THIRTY MINUTES BEFORE PROCEEDING WITH CALIBRATION.

2. Remove back cover from instrument, using procedure described in Step 3.1.

3. Adjust output of DC calibrator for 190mV ±0.02% and connect to volt/ohm and COM input connectors on Multimeters.

4. Turn Function/Range Switch on Multimeter to 200mV DCV position.

5. Using small flat-tipped screwdriver, adjust potentiometer R5 (as shown in Figure 5) until Multimeter display reads +190.0 or +190.1.

6. Disconnect DC calibrator from Multimeter.

7. Replace back cover and secure.

3.8.2 Calibration of True-RMS Models

1. Perform DC calibration as just described.

2. Short Multimeter voltage input terminals.

3. Turn Function/Range Switch to 1000V ACV position.

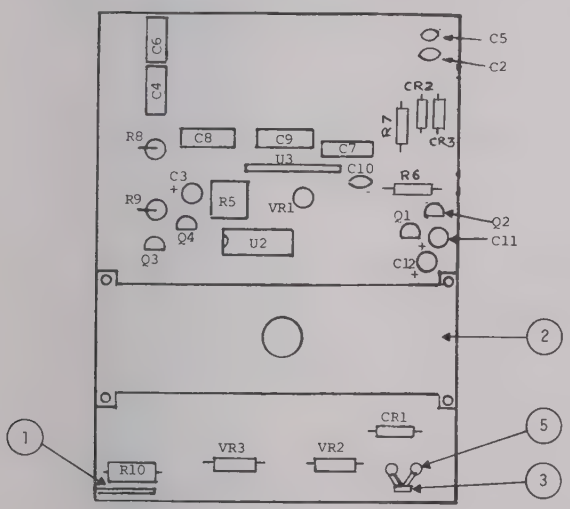



FIGURE 5. LARGE CIRCUIT BOARD NON-RMS MODELS

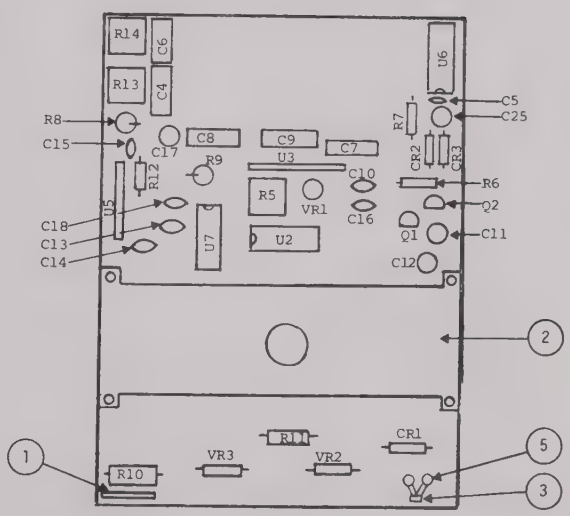



FIGURE 6. LARGE CIRCUIT BOARD RMS MODELS

4. Adjust potentiometer R13--the AC zero adjustment (shown in Figure 6)--until the digital display reads 000 or 001. Make this adjustment very slowly to allow instrument to stabilize.

5. Turn Function/Range Switch to 200mV ACV position.

6. Set output of DC calibrator to 190mV. Connect DC calibrator to V/Ohm and COM inputs on Multimeter (polarity is not important).

7. Adjust potentiometer R14--the AC fullscale adjustment (shown in Figure 6)--until digital display reads 190.0 ±1 digit.

8. Disconnect DC calibrator from Multimeter.

9. Place Function/Range Switch on Multimeter in 2V ACV position and set AC calibrator for output of 1.900V, 20kHz.

10. Temporarily reinstall back cover of Multimeter.

11. Connect AC calibrator to V/Ohm and COM inputs and note reading. Ensure that COM or "low" side terminal of AC calibrator is matched with Multimeter COM input.

12. Remove Multimeter back cover and again note display reading. The difference between the first and second readings is the error voltage.

    Note: At 20kHz, (calibration frequency) 2Vac Multimeter readings tend to be higher with back cover shield removed than with cover attached. Adjust Multimeter to read higher than calibration standard voltage so that, with cover attached, desired output is achieved.

13. Adjust trimming capacitor C19--high-frequency adjust (as shown in Figure 7)--until the display reads a value equal to 1.900 plus the error voltage.

14. Reinstall Multimeter back cover and secure.

15. Verify that the display reads 1.900 ±20 digits.

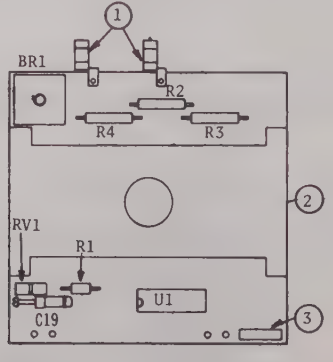



FIGURE 7. SMALL CIRCUIT BOARD RMS MODELS

# A. REPAIR DECISION TREE

## I METER IN 2 VDC RANGE (NO INPUT)

### A DISPLAY BLANK

1) CHECK BATTERY VOLTAGE (>8.00V).
2) CHECK BATTERY LEADS FOR CONTINUITY.
3) CHECK SWITCH--*See Note 1.*
4) CHECK CURRENT OF MODULE:
   A) DISCONNECT ONE BATTERY TERMINAL.
   B) PLACE ONE LEAD OF METER INTO DISCONNECTED TERMINAL OF BATTERY AND OTHER LEAD INTO DISCONNECTED BATTERY SNAP TERMINAL.
   CURRENT OF MODULE SHOULD READ FROM "0.230 MA" TO "0.400 MA."

IF CURRENT READING IS

#### 1 OL

1) CHANGE THE MULTIPROCESSOR CHIP (U4). EVEN IF THIS FIXES PROBLEM, CHECK RESISTOR NETWORK ATTENUATOR (U1)--*See Note 2.*
2) INSPECT SMALL SIGNAL DIODE (CR1) NEAR BATTERY LEADS. DIODE TEST SHOULD READ APPROX "0.6" TO "0.75."
   IF IT READS "OL" BOTH DIRECTIONS, REPLACE DIODE (CR1).

A) IF DIODE (CR1) READS LOW (.050, .000), CHECK CAPACITOR (C1) TO DETERMINE IF IT IS SHORTED. READING SHOULD BE "OL."
B) IF CAPACITOR (C1) IS OKAY, CHECK CAPACITOR (C11) THE SAME WAY.
C) IF CAPACITORS (C1,C11) ARE OKAY, REPLACE SMALL SIGNAL DIODE (CR1).
D) IF CAPACITOR (C1) IS OKAY BUT SOLDER PADS GIVE A SHORTED READING, REMOVE MULTIPROCESSOR CHIP (U4) AND RESET.
E) VISUALLY INSPECT BOARD FOR PC SHORTS.

#### 2 ±.000 (MODULE NOT IN OFF POSITION)

1) CHECK SWITCH (13B) FOR OPEN.
2) INSPECT HEADGEAR PLASTICS ASSEMBLY FOR PROPER ASSEMBLY.
3) CLEAN PC BOARD UNDER SILVER ELASTOMERIC CONNECTORS BETWEEN LARGE PC BOARD AND MULTIPROCESSOR CHIP (U4).
4) REPLACE SILVER ELASTOMERIC CONNECTORS.
5) CHECK LARGE PC BOARD POWER TRACE FROM "+" SIDE OF BATTERY PAD TO CHIP PAD #21--*See Note 4.*

#### 3 CORRECT

1) CHECK THAT LCD IS INSTALLED CORRECTLY.
2) CLEAN PC BOARD UNDER CARBON ELASTOMERIC CONNECTOR BETWEEN LARGE PC BOARD AND LCD DISPLAY.

### B DISPLAY READS "0.00"

1) CHECK SWITCH--*See Note 1.*
2) CHECK 3-PIN CONNECTORS BETWEEN BOARDS FOR CONTINUITY.
3) IF READING IS "OL" ON ALL RANGES, REPLACE MULTIPROCESSOR CHIP (U4).
4) CHECK RESISTOR NETWORK ATTENUATOR (U1)--*See Note 2.*
5) CHECK REF DIODE (VR1). SHOULD READ "-1.2 VDC ±0.05V."
6) CHECK THIN FILM RESISTOR DIVIDER (U2). SHOULD READ: PINS 6-7, 30KΩ; PINS 5-6, 132KΩ
7) CHECK CAPACITOR (C6)--*See Note 3.*

### C DOES NOT ZERO

1) CHECK REF DIODE (VR1). SHOULD READ "-1.2 VDC ±0.05V."
2) CLEAN PC BOARD AREA UNDER SILVER ELASTOMERIC CONNECTORS BETWEEN LARGE PC BOARD AND MULTIPROCESSOR CHIP (U4).
3) REPLACE SILVER ELASTOMERIC CONNECTORS--*See Note 6.*
4) CHECK IF PC BOARDS ARE DIRTY. TURN METER TO "2 VDC," BREATHE ON MODULE NEAR FUSE, AND IF ALL KINDS OF NUMBERS APPEAR, CLEAN BOARD.
5) SHORT CAPACITOR (C4) TO COMMON. IF METER "ZEROES," REPLACE CAPACITOR.

## II METER IN VDC:

1) CALIBRATE WITH 190.0 MV INPUT
2) CHECK WITH 190.0 V INPUT

### A READS "000"

1) CHECK SILVER ELASTOMERIC CONNECTORS--*See Note 6.*
2) CHECK SWITCHES--*See Note 1.*
3) CHECK SPARK GAP (SG1) TO SEE IF IT IS SHORTED.
4) CHECK 10-PIN SIP RESISTOR NETWORK (U3).
5) REPLACE MULTIPROCESSOR CHIP (U4).

### B READING UNSTABLE

1) CHECK SWITCHES--*See Note 1.*
2) CHECK RESISTOR NETWORK ATTENUATOR (U1)--*See Note 2.*
3) CHECK 2KΩ ±5% RESISTOR (R1) FOR OPEN OR SHORT.
4) CHECK CAPACITORS (C7,C10)--*See Note 3.* IF REVERSING INPUT LEADS STABILIZES DISPLAY, REPLACE CAPACITOR (C9).
   CHECK FEED-THROUGH FROM CAPACITOR (C10) TO MULTIPROCESSOR CHIP (U4) TO CAPACITORS (C6,C7) FOR CONTINUITY.
5) REPLACE SILVER ELASTOMERIC CONNECTORS--*See Note 6.*
6) REPLACE MULTIPROCESSOR CHIP (U4).

### C READING INCORRECT

1) CHECK REF DIODE (VR1). SHOULD READ "1.2 VDC ±0.05V."
2) CHECK 10K POT (R5) FOR OPEN OR SHORT.
3) CHECK RESISTOR NETWORK ATTENUATOR (U1)--*See Note 2.*
4) CHECK 2MΩ ±5% RESISTOR (R8).
5) REPLACE MULTIPROCESSOR CHIP (U4).
6) CHECK FOR OPEN TRACE ON SMALL PC BOARD BETWEEN Vα INPUT TERMINAL PIN AND SOLDER PAD--#1 OF FEMALE 5-PIN CONNECTOR. SHOULD READ APPROX "2KΩ."
7) CHECK SWITCHES--*See Note 1.*
8) CHECK CAPACITOR (C11)--*See Note 3.*

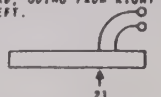
*NOTE 1 - CHECK SWITCHES: USING THE DIAGRAM, IT SHOWS WHICH SWITCH IS SUPPOSED TO BE OPEN OR CLOSED ON EVERY RANGE. THE SWITCHES ON SMALL BOARD ARE 1A TO 16A; ON BIG BOARD, 1B TO 16B. NUMBERING STARTS FROM CENTER; ODD ON ONE SIDE, EVEN ON OTHER.

*NOTE 2 - CHECK ATTENUATOR RANGES: THE MODULE ON 1500 VDC RANGE WITH BATTERY DISCONNECTED SHOULD READ:

| BETWEEN PINS | | |
|---|---|---|
| PINS | 1-14 | 19.8MΩ |
| PINS | 1-4 | 1.98MΩ |
| PINS | 4-5 | 198KΩ |
| PINS | 5-6 | 19.8KΩ |
| PINS | 6-7 | 1.98KΩ |
| PINS | 7-8 | 220Ω |
| PINS | 9-10 | 90Ω |
| PINS | 10-11 | 900Ω |

NOTE 3 - CAPACITORS: ON 20MΩ RANGE, OHM SIGN SHOULD APPEAR AND "OL" SHOULD APPEAR (CAPACITOR >.01 μF).

NOTE 4 - CHIP PAD #21: THE TENTH PAD, GOING FROM RIGHT TO LEFT.




NOTE 5 - CAUTION ON HANDLING CHIP.

NOTE 6 - SILVER ELASTOMERIC CONNECTORS: CLEAN WITH RUBBER ERASER. MAKE SURE RESIDUE OF RUBBER IS REMOVED WITH KIMWIPE (OR EQUIVALENT).

*CONNECTORS

BETWEEN BOARDS, AND NUMBERING FROM THE EDGE, ARE PINS 1 TO 5 (DESIGNATED "J" ON THE SHEMATIC):

P4 (FOURTH FROM EDGE) IS COMMON.

P2 AND P3 SHOULD READ ".400V" AND 600A ONLY ON OHM RANGES AND DIODE TEST.

P1 IS VOLTS.

P5 IS CURRENT.

## III — ACV AND/OR ACA RANGES NOT CORRECT

**A — READS "000"**

1) CHECK TRANSISTORS (Q3,Q4) FOR SHORT.
2) REPLACE MULTIPROCESSOR CHIP (U4).
3) CHECK 3.3 µF CAPACITOR (C12) USING 20K RANGE OF METER. IT SHOULD READ APPROX "11.1K." IF READING IS "0.00," CLIP ONE LEAD AND RECHECK.
4) IF CAPACITOR (C12) READS "OL," CHECK FOR SOLDER BRIDGES BETWEEN CAPACITOR (C12) AND SOLDER PADS.
5) INSPECT TRACE FROM SWITCH 15B TO AC CONVERTER (CHIP PAD #1 OR RMS CHIP PIN #8) AND CHECK IF OPEN.
6) CHECK THIN FILM REF DIVIDER (U2).

**B — ACV**

1 UNSTABLE
1) CHECK SWITCHES--*See Note 1.*
2) CHECK TRANSISTORS (Q1,Q3,Q4).
3) CHECK CAPACITORS (C7,C9) FOR SHORTS.

2 OUT OF TOLERANCE
1) CHECK SWITCHES--*See Note 1.*
2) CHECK RESISTOR ATTENUATOR (U1) RANGES.
3) REPLACE MULTIPROCESSOR CHIP (U4).
4) CHECK THIN FILM REF DIVIDER (U2). BETWEEN PINS 9-10, SHOULD READ "5kΩ." PINS 8-9, SHOULD READ "11.1kΩ."
5) CHECK CAPACITORS (C3,C6) FOR SHORTS.

3 "000"
1) CHECK SWITCHES--*See Note 1.*
2) CHECK THIN FILM REF DIVIDER (U2) AND 10-PIN SIP RESISTOR NETWORK (U3, PINS 5,6).
3) CHECK 2MΩ ±5% RESISTOR (R8).
4) CHECK CAPACITORS (C8,C12) FOR SHORTS.
5) CHECK THIN FILM RESISTOR NETWORK (U2). PIN 2 SHOULD READ "-5.00V ±5%."
6) REPLACE MULTIPROCESSOR CHIP (U4).

4 "OL"
1) CHECK SWITCHES--*See Note 1.*
2) CHECK CALIBRATION (190 MV OR 200 MV DC).
3) CHECK REF DIODE (VR1).
4) CHECK RESISTOR NETWORK ATTENUATOR (U1)--*See Note 1.*
5) CHECK RESISTORS (R5,R6)
6) CHECK THIN FILM RESISTOR NETWORK (U2). PIN 2 SHOULD READ "-5.00V ±5%."
7) CHECK CAPACITOR (C6) FOR SHORTS.

## IV — 1500 VDC 1000 VAC READS "000"

1) CHECK RESISTOR NETWORK ATTENUATOR (U1)--*See Note 1.*
2) CHECK SPARK GAP (SG1)--WARNING: *Disconnect input leads first.* CLIP ONE LEAD OF SPARK GAP. METER SHOULD READ CORRECT VALUE.

## V — ACA & DCA READINGS NOT CORRECT

**A "000"**

1) CHECK FUSE AND FUSE CLIP TO INSURE GOOD CONTACT.
2) CHECK 2-AMP BRIDGE (BR1). PLACE TEST LEADS ACROSS TWO INPUT PINS. READING SHOULD BE "+1.200."

**B "OL"**

1) CHECK RESISTOR NETWORK ATTENUATOR (U1)--*See Note 1.*
2) IF ACA READS "0.00" AND DCA READS "OL":
   A) INSPECT SWITCH BLOCK FOR BURNS.
   B) CHECK IF 5-PIN CONNECTORS BETWEEN SMALL AND LARGE PC BOARDS ARE PROPERLY JOINED.

**C OUT OF TOLERANCE**

1) CHECK RESISTOR NETWORK ATTENUATOR (U1). PINS 9-10 SHOULD READ 90 OHMS. PINS 10-11 SHOULD READ 900 OHMS.
2) CHECK RESISTORS: R2 = 9.0 ± 1/4%
   R2 = 0.1 ± 1/4%
   R3 = 0.9 ± 1/4%

## VI — OHMS READING NOT CORRECT

1) CHECK IF DCV AND ACV RANGES READ CORRECTLY. CHECK TRANSISTORS (Q1,Q2).
2) IF DCV AND ACV RANGES FAIL, ALSO CHECK RESISTOR NETWORK ATTENUATOR (U1)--*See Note 1.*
3) CHECK SWITCHES--*See Note 1.*
4) MEASURE VOLTAGE BETWEEN Vo INPUT AND COMMON INPUT TERMINALS OF MODULE. SHOULD READ "0.400V." ALSO CHECK VOLTAGE BETWEEN COMMON AND PINS (P2,P3). SHOULD READ APPROX "0.400V."
   IF VOLTAGE IS NOT APPROX "0.400V": CHANGE MULTIPROCESSOR CHIP (U4).
   CHECK 10-PIN SIP RESISTOR NETWORK (U3).
   CHECK TRANSISTOR (Q2) COLLECTOR TO SEE IF IT IS SAME VOLTAGE AS EMITTER. IF SO, CLIP EMITTER LEAD AND RECHECK. IF READING IS SIGNIFICANTLY LOWER, TRANSISTOR IS SHORTED.
   CHECK TRANSISTOR (Q1) IN THE SAME MANNER.
5) IF OHM RANGES AND DIODE TEST READ LOW OR "0.00": CHECK ZENER DIODES (VR2,VR3) WITH PC BOARDS SEPARATED. SHOULD READ "0.700V." CHECK RESISTOR (R10). SHOULD READ ".250" TO ".5."
6) IF OHMS UNSTABLE OR "OL": CHECK 5-PIN CONNECTORS FOR CONTINUITY. CHECK SWITCHES--*See Note 1.*
7) IF DIODE READING IS LOW OR "0.00," CHECK TRANSISTOR (Q1).
8) IF DIODE READING IS HIGH, CHECK 100Ω ±5% RESISTOR (R6).

## VII — FLASHING DECIMAL

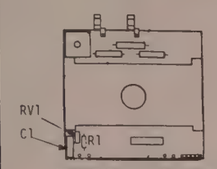
1) CHECK BATTERY VOLTAGE (>8.00V).
2) CHECK MULTIPROCESSOR CHIP (U4; PINS 21,22) FOR CONTINUITY.
3) CHECK SWITCHES--*See Note 1.*
4) REPLACE MULTIPROCESSOR CHIP (U4).
5) REPLACE LCD.
6) REPLACE SILVER ELASTOMERIC CONNECTORS--*See Note 6.*

# B. P.C. BOARD CROSS REFERENCE BY VICTOR TOLAN

● FIRST GENERATION ●● SECOND GENERATION ●●● THIRD GENERATION ●●●● FOURTH GENERATION

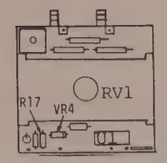
## INPUT BOARD

**S**




3000-502-008

**N**

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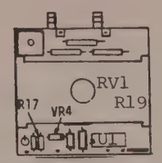


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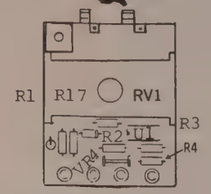


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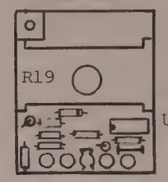


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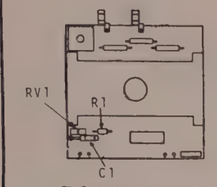
**T**

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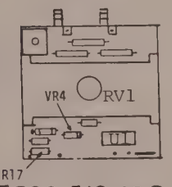
**M**

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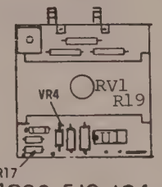
**D**

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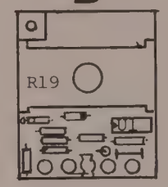
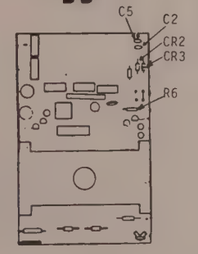



3000-510-114

## DISPLAY BOARD

**W**




3000-501-008

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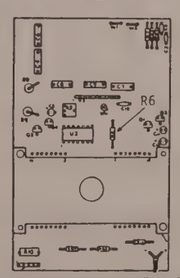


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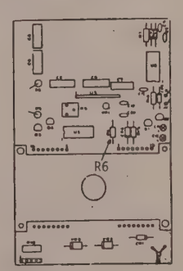


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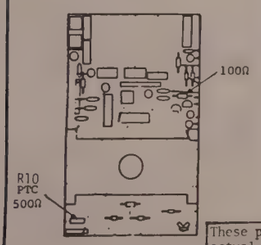
**X**

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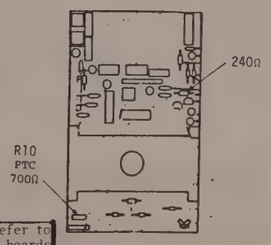
**Z**




3000-510-100

These part numbers refer to actual number on the boards

| MODEL | PART NUMBER ON DISPLAY PC BOARD | REPLACEMENT BOARD ORDERING NUMBER | PART NUMBER ON INPUT PC BOARD | REPLACEMENT BOARD ORDERING NUMBER |
|---|---|---|---|---|
| *HD-100 | (R) 3000-510-108 | FG3000-980-113 | (N) 3000-510-107<br>**(Q) 3000-526-23<br>(C) 3000-510-122<br>**(A) 3000-510-115 | FG3000-980-112<br>FG3000-980-117<br>FG3000-980-112<br>FG3000-980-117 |
| *HD-110 | (R) 3000-510-108 | FG3000-980-113 | **(Q) 3000-526-23<br>**(A) 3000-510-105 | FG3000-980-117<br>FG3000-980-117 |
| TECH 300 | (W) 3000-501-008<br>(R) 3000-510-108 | FG3000-980-113<br>FG3000-980-113 | (S) 3000-502-008<br>(N) 3000-510-107<br>**(A) 3000-510-115<br>**(Q) 3000-526-23<br>(C) 3000-510-122 | FG3000-980-112<br>FG3000-980-112<br>FG3000-980-117<br>FG3000-980-117<br>FG3000-980-112 |
| 3000, TECH 310, 3010, TECH 310UL, 3010UL, 3020 | (W) 3000-501-008<br>(R) 3000-510-108 | FG3000-980-113<br>FG3000-980-113 | (S) 3000-502-008<br>(N) 3000-510-107<br>(C) 3000-510-122<br>*(Q) 3000-526-23<br>**(A) 3000-510-115 | FG3000-980-112<br>FG3000-980-112<br>FG3000-980-112<br>FG3000-980-117<br>FG3000-980-117 |
| 3020B TECH 320B | (P) 3000-510-108 | FG3000-980-116 | (N) 3000-510-107<br>**(Q) 3000-526-23<br>*(A) 3000-510-115<br>(C) 3000-510-122 | FG3000-980-112<br>FG3000-980-117<br>FG3000-980-117<br>FG3000-980-112 |
| 3030 TECH 330 | (X) 3000-510-100<br>(Z) 3000-510-100 | FG3000-980-111<br>FG3000-980-111 | (T) 3000-500-008<br>(M) 3000-510-109<br>*(B) 3000-510-114<br>(D) 3000-510-124 | FG3000-980-114<br>FG3000-980-114<br>FG3000-980-115<br>FG3000-980-114 |

*All HD-type meters require straight-end test leads
**If Q,A, or B boards are used, a new front case and straight-end test leads are required

•EXAMPLE OF HOW TO USE THIS TABLE: Let's say that one has a Model 3000 or Tech 310, and the input board (part number printed on the board--3000-502-008) needs to be replaced. To get the replacement board, one should order (according to this table) FG3000-980-112.

## GENERAL NOTES:

I. DIFFERENCES BETWEEN FIRST GENERATION AND SECOND GENERATION:

Second generation input boards have the following changes:

1) RV1, MOV (FG3000-80-102), instead of spark gap
2) R1, 2KΩ, 1/2W resistor (FG3000-031-202), instead of 2KΩ, 1/4W resistor
3) VR4, zener diode (FG3000-231-101)
4) R17, 240Ω, 1/2W resistor (FG3000-031-241)

Second generation display boards have the following changes:

1) R10, 750Ω PTC (FG3000-082-103), instead of 500Ω PTC
2) R6, 240Ω, 1/4W resistor (FG3000-1-241) instead of 100Ω resistor

These changes will provide a 2mA output on diode test instead of 5mA, and a 500 Vdc overload protection on resistance ranges instead of 300 Vdc.

II. DIFFERENCES BETWEEN SECOND AND THIRD GENERATION

Third generation input boards have the following changes:

1) Input jacks are on board instead of on front case
2) R4, .0898Ω resistor (FG3000-071-104), instead of .1Ω
3) 10A shunt (FG3000-040-101) is on the board instead of on the front case.

Third generation front cases are designed to accept the new input jacks.

III. WHEN SECOND GENERATION INPUT BOARDS ARE USED WITH FIRST GENERATION DISPLAY BOARDS, THE FOLLOWING CHANGES MUST BE MADE:

1) Replace 100Ω resistor (R6) with 240Ω (FG3000-1-241)
2) Replace 500Ω PTC (R10) with 750Ω PTC (FG3000-82-103)

These changes provide a 2mA output on diode test instead of 5mA and provide a 500 Vdc overload protection on resistance ranges instead of 300 Vdc.

IV. TO ACCOMMODATE THE FLEX CABLE CONNECTOR OF THE INPUT BOARDS, THE FEMALE 5-PIN CONNECTOR (FG3000-370-144) NEEDS TO REPLACE THE SOLID 5-PIN CONNECTOR ON THE DISPLAY BOARD.

V. ALL INPUT BOARDS WILL HAVE HIGHEST GRADE (.1%) ATTENUATORS (FG3000-313-101)

VI. DO NOT USE FIRST GENERATION INPUT BOARDS WITH SECOND GENERATION DISPLAY BOARDS.

VII. DIFFERENCES BETWEEN THIRD AND FOUR GENERATION

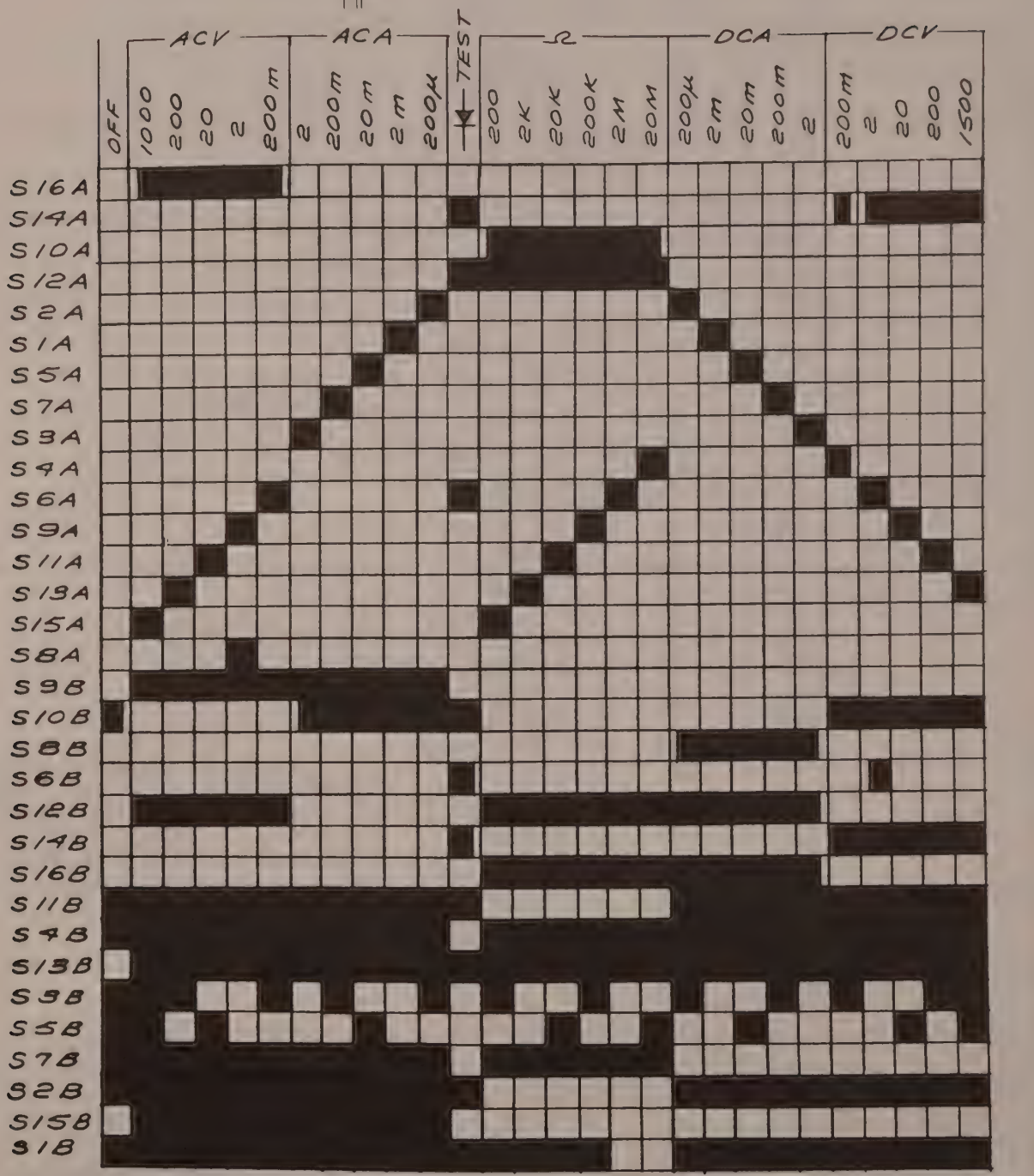
1) The fuse clips are moved from the top of the board to the bottom of the board
2) A 19.8MΩ (R19) discrete resistor is added to replace the one from the attenuator (U1), making it a 2.2MΩ attenuator (U1).

VIII. THE REPLACEMENT BOARDS FOR THE FIRST TWO GENERATIONS—(S,N) AND (T,M)—ARE SHOWN IN FIGURES C AND D. THEY ALSO HAVE A TWO-PIECE ATTENUATOR.

S = Switch Contact
A = Input (Small) Board
B = Display (Large) Board

SOLID SQUARE INDICATES SWITCH CLOSED

GAP INDICATES BREAK-BEFORE-MAKE ACTION

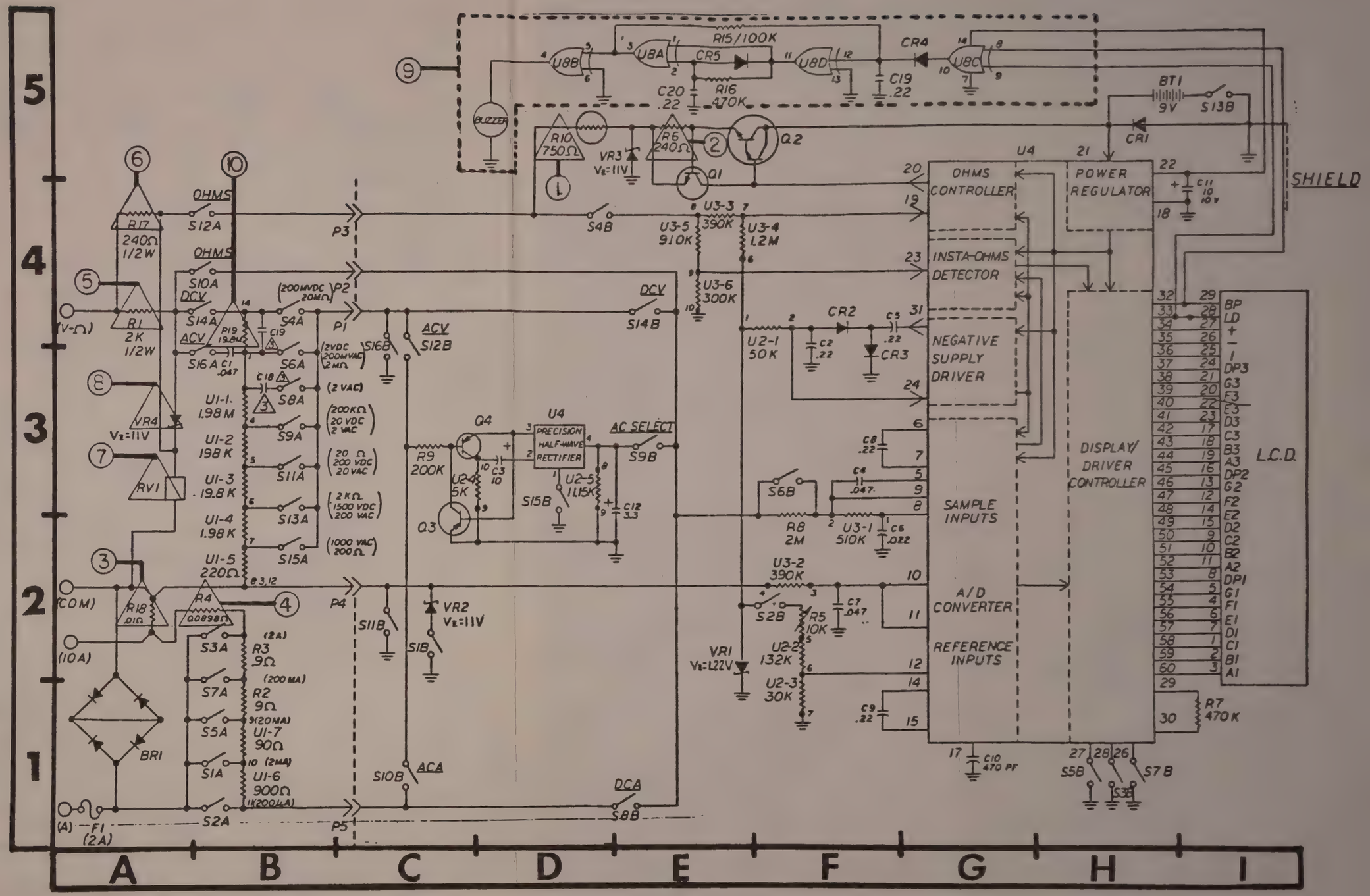



**C. FUNCTION/RANGE SWITCH CONTACT POSITION MATRIX HAND-HELD METERS**

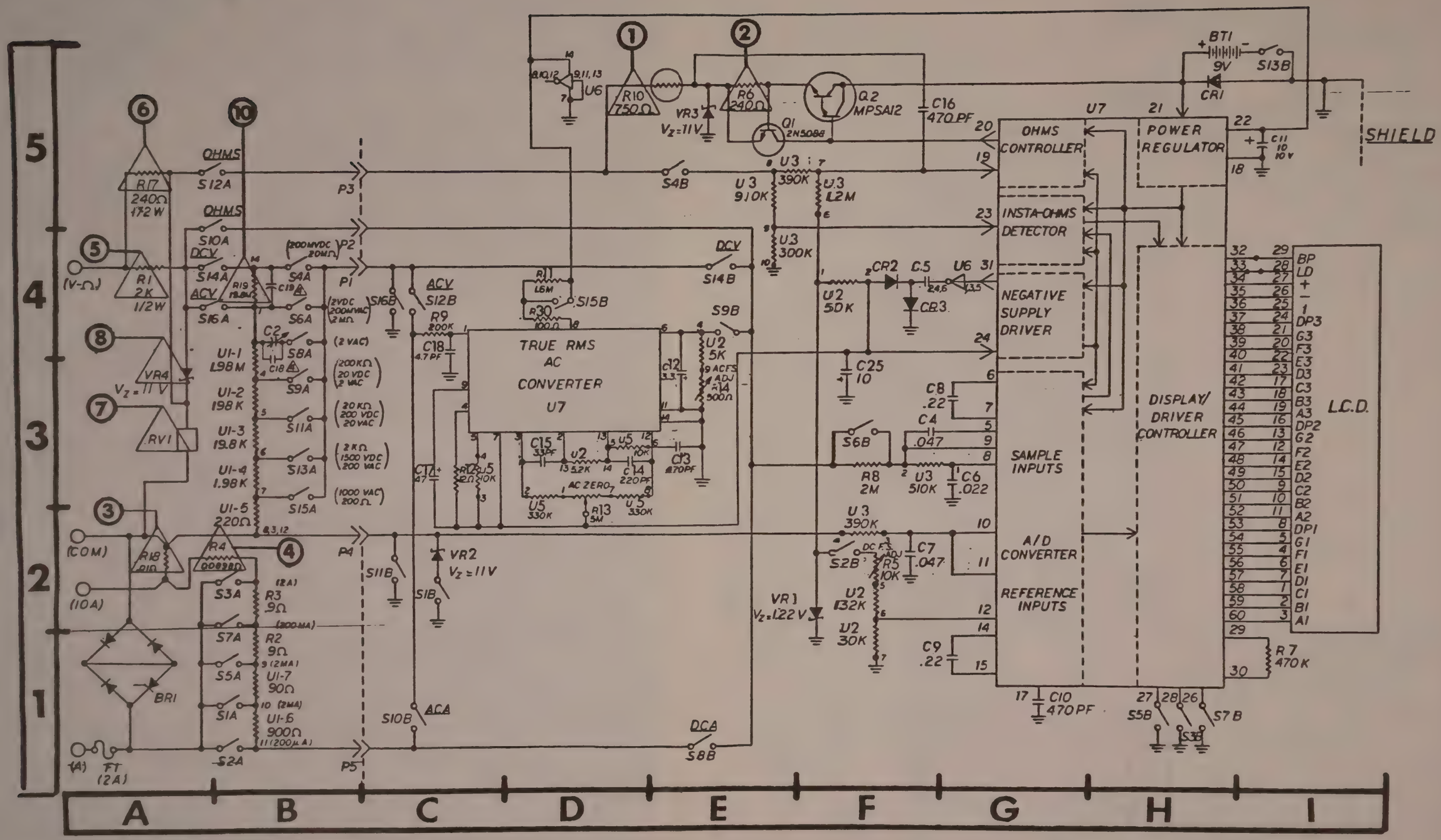
CLOCKWISE ⟶

# NOTES

| NBR | PART ON SCHEMATIC | BOARD NBR | DESCRIPTION | COMMENTS |
|---|---|---|---|---|
| 1 | R10 | 3000-501-008<br>3000-510-100<br>3000-510-108 | 500Ω PTC<br>500Ω PTC<br>750Ω PTC | |
| 2 | R6 | 3000-501-008<br>3000-510-100<br>3000-510-108 | 100Ω Resistor<br>100Ω Resistor<br>240Ω Resistor | 3000-510-108: 2mA on diode test |
| 3 | R18 | 3000-526-023<br>3000-510-114<br>3000-510-115 | .01Ω Shunt<br>.01Ω Shunt<br>.01Ω Shunt | 10A switch on board instead of mechanism |
| 4 | R4 | 3000-510-115<br>3000-526-023<br>3000-510-114<br>3000-502-008<br>3000-510-107<br>3000-510-109<br>3000-500-008 | .0898Ω Res.<br>.0898Ω Res.<br>.0898Ω Res.<br>.1Ω Res.<br>.1Ω Res.<br>.1Ω Res.<br>.1Ω Res. | Part of 10A switch on board |
| 5 | R1 | 3000-500-008<br>3000-502-008<br>3000-526-023<br>3000-510-107<br>3000-510-114<br>3000-510-109<br>3000-510-115<br>3000-510-122<br>3000-510-124 | 2KΩ 1/4W Res.<br>2KΩ 1/4W Res.<br>2KΩ 1/2W Res.<br>2KΩ 1/2W Res.<br>2KΩ 1/2W Res.<br>2KΩ 1/2W Res.<br>2KΩ 1/2W Res.<br>2KΩ 1/2W Res.<br>2KΩ 1/2W Res. | Better protection |
| 6 | R17 | 3000-526-023<br>3000-510-114<br>3000-510-107<br>3000-510-109<br>3000-510-115<br>3000-510-122<br>3000-510-124 | 240Ω 1/2W Res.<br>240Ω 1/2W Res.<br>240Ω 1/2W Res.<br>240Ω 1/2W Res.<br>240Ω1/2W Res.<br>240Ω1/2W Res.<br>240Ω1/2W Res. | Better protection |
| 7 | RV1 | 3000-500-008<br>3000-502-008 | Spark Gap<br>(Gray) | If meter was never serviced, it probably still has spark gap, and this should be replaced with MOV (S3000). |
| 8 | VR4 | 3000-526-023<br>3000-510-114<br>3000-510-107<br>3000-510-109<br>3000-510-115<br>3000-510-122<br>3000-510-124 | Zener Diode<br>Zener Diode<br>Zener Diode<br>Zener Diode<br>Zener Diode<br>Zener Diode<br>Zener Diode | Better protection |
| 9 | Beeper Circuitry | 3000-510-108 | | Only on beeper models, 3020B or Tech 320B |
| 10 | R19 | 3000-502-008<br>3000-500-008<br>3000-510-107<br>3000-510-109<br>3000-526-023 | 19.8MΩ Res. | On these boards the 19.8MΩ resistor was part of the attenuator U1. |




**D. SCHEMATIC—3½ DIGIT NON-RMS MULTIMETERS**




**E. SCHEMATIC—3½ DIGIT RMS MULTIMETERS**

SECTION THREE

# REPLACEMENT PARTS AND SUPPLIES

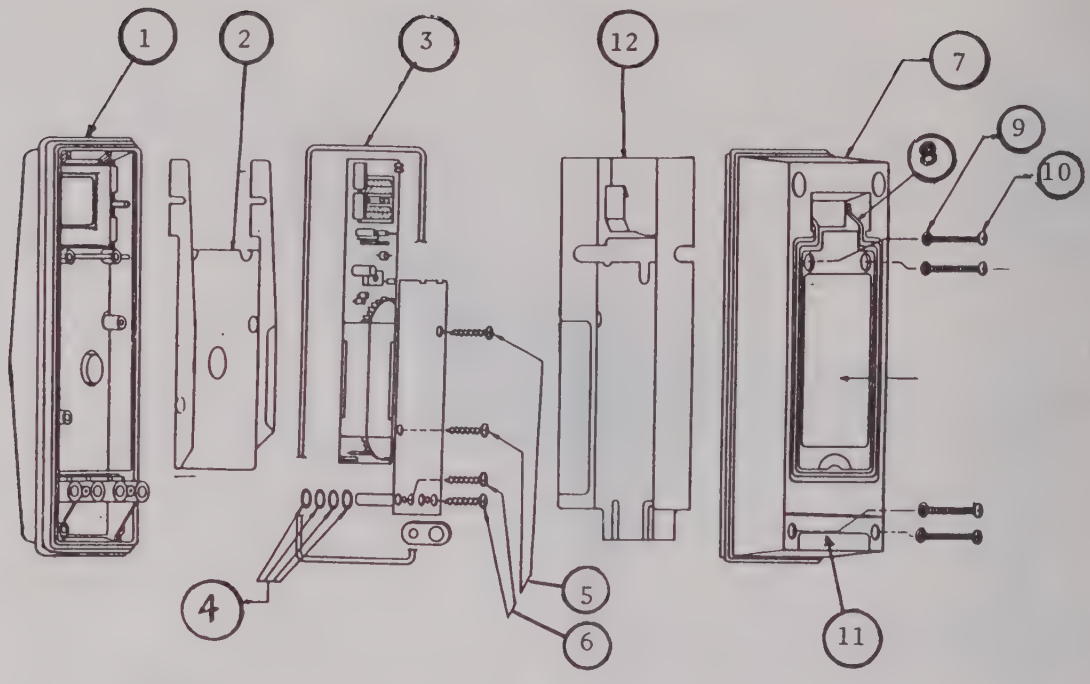
The replacement parts and supplies listed in this section may be ordered from Beckman, or your local service center. Beckman requires CASH-IN-ADVANCE to be sent along with your order to the address listed below. A sample order form is enclosed at the back of this manual. Please make sure you use it to order parts.

To determine Beckman part number and description of the part to be replaced, first find the part located on an illustration. Next, note the illustration figure number or parts index number. Locate the identical figure number on the parts list. Notice the schematic description.

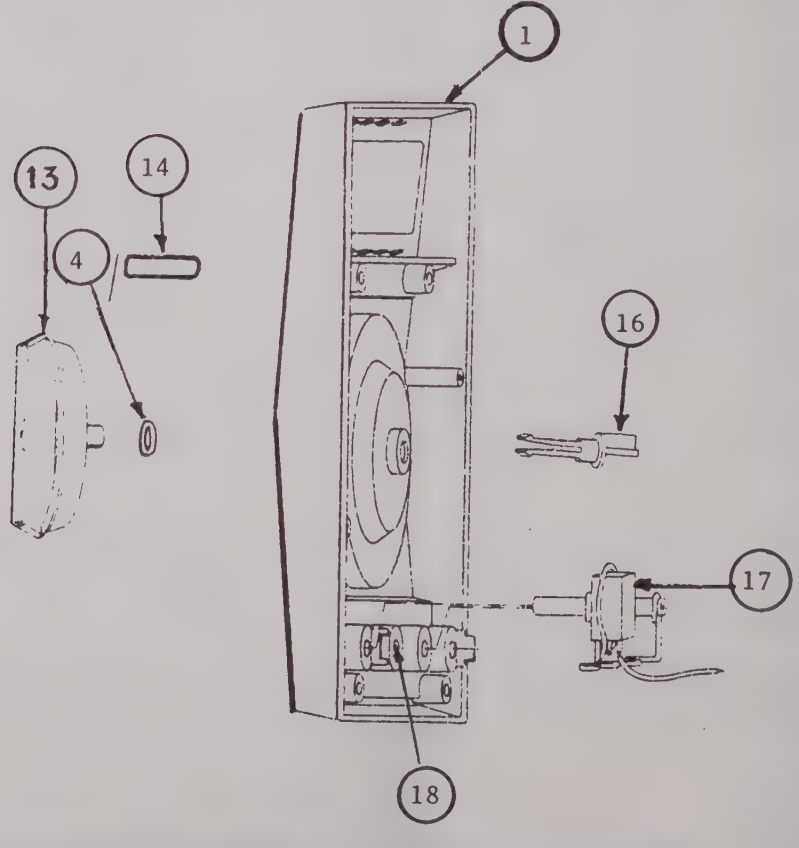
Please note Beckman address:

Beckman Instruments, Inc.
630 Puente Street
Brea, CA 92621
Attention: Customer Service

# MULTIMETER ASSEMBLY




FRONT HOUSING ASSEMBLY TO MATCH STRAIGHT-END TEST LEADS




FRONT HOUSING ASSEMBLY TO MATCH RIGHT-ANGLE TEST LEADS

## MULTIMETER ASSEMBLY

PARTS INCLUDED IN FRONT CASE ASSEMBLIES ARE: CASE PLASTIC, SHAFT, WINDOW, WINDOW SEAL, AND INPUT JACK OVERLAY. THE NAME LOGO IS THE ONLY PART NOT INCLUDED ON CASES WHICH CAN BE INTERCHANGED. LOGOS CAN BE PURCHASED SEPARATELY.

PARTS INCLUDED IN REAR CASE ASSEMBLY ARE: REAR PLASTIC CASE, BATTERY COVER, BAIL, RUBBER FEET, RUBBER STRIPS. REAR CASES LISTED MATCH WITH EITHER OF THE FRONT CASES SHOWN.

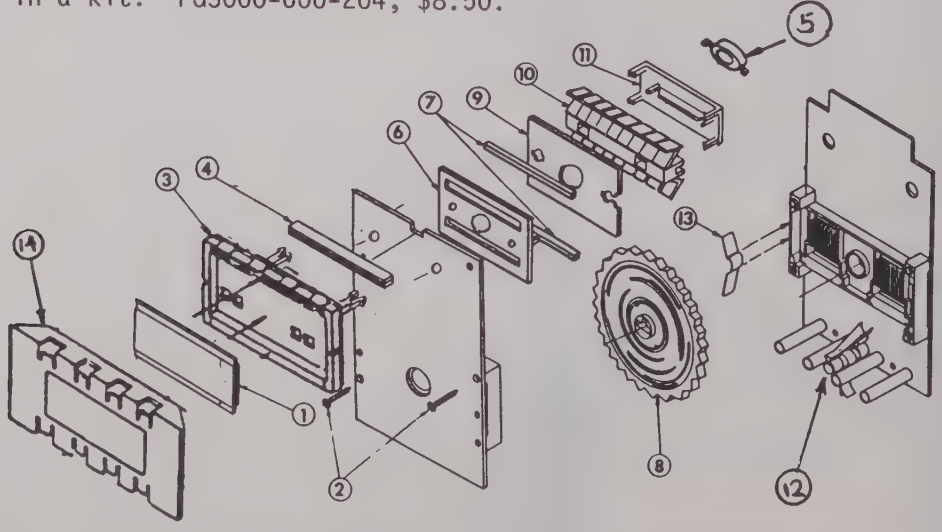
| INDEX NBR | BECKMAN PART NBR | DESCRIPTION | SUGGESTED RETAIL* |
|---|---|---|---|
| | FRONT BASE ASSEMBLIES AND PARTICULAR PARTS TO MATCH RIGHT ANGLE TEST LEADS: | | |
| 1 | FG3000-410-111 | TECH 300 | 13.30 |
| | FG3000-410-110 | 3000 | 13.30 |
| | FG3000-410-110 | 3010,3020,3030,3020B | 13.30 |
| | FG3000-421-144 | 3010UL | 13.30 |
| | FG3000-410-112 | TECH 310,TECH 330, TECH 320B | 13.30 |
| | FG3000-420-172 | HD-100 | 23.00 |
| 17 | FG3000-526-21 | 10-AMPERE SHUNT ASSEMBLY | 8.00 |
| 17 | FG3000-526-22 | 10-AMPERE SHUNT ASSEMBLY - UL ONLY | 10.00 |
| 2 | FG3000-450-116 | SHIELD - UPPER | 1.50 |
| | FG3000-410-116 | BATTERY COVER ASSEMBLY | 3.36 |
| 18 | FG3000-543-21 | JACK ASSEMBLY KIT | 1.40 |
| 18 | FG3000-543-23 | JACK ASSEMBLY KIT - UL METERS | 2.00 |
| | FRONT CASE ASSEMBLIES TO MATCH STRAIGHT END TEST LEADS | | |
| 1 | FG3000-572-100 | TECH 300 | 13.30 |
| | FG3000-571-106 | 3000 | 13.30 |
| | FG3000-980-132 | TECH 310,TECH 330, TECH 320B | 13.30 |
| | FG3000-572-119 | TECH 310UL | 13.30 |
| | FG3000-980-133 | 3010,3020,3020B,3030 | 13.30 |
| | FG3000-572-118 | 3010UL | 13.30 |
| | FG3000-980-118 | HD-100, HD-110 | 23.00 |
| | PARTS WHICH ARE USED IN BOTH STYLES OF METERS | | |
| 14 | FG3000-920-301 | TECH 310 LOGO | 1.50 |
| | FG3000-920-303 | TECH 320B LOGO | 1.50 |
| | FG3000-920-302 | TECH 330 LOGO | 1.50 |
| | FG3000-920-310 | 3010 LOGO | 1.50 |
| | FG3000-920-320 | 3020 LOGO | 1.50 |
| | FG3000-920-330 | 3030 LOGO | 1.50 |
| | FG3000-920-322 | 3020B LOGO | 1.50 |
| | FG3000-920-299 | HD-100 LOGO | 1.50 |
| | FG3000-920-112 | HD-110 LOGO | 1.50 |
| 12 | FG3000-410-115 | SHIELD - LOWER | 1.50 |
| 3 | FG3000-450-151 | CASE SEAL (HD SERIES ONLY) | 3.10 |
| 4 | FG3000-450-105 | O-RING FOR INPUT JACKS | .16 |
| 5 | FG3000-450-103 | SCREW #4 - LONG | .16 |
| 6 | FG3000-450-106 | SCREW #4 - SHORT | .16 |
| 16 | FG3000-420-102 | SHAFT | 1.00 |
| 4 | FG3000-450-105 | O-RING | .16 |
| 13 | FG3000-420-105 | KNOB, FUNCTION/RANGE SWITCH, SERIES 300 | 1.20 |
| | FG3000-421-105 | KNOB, FUNCTION/RANGE SWITCH, SERIES 3000 | 1.20 |
| 7 | FG3000-980-128 | SERIES 300 REAR HOUSING ASSEMBLY | 7.00 |
| | FG3000-980-129 | SERIES 3000 REAR HOUSING ASSEMBLY | 7.00 |
| | FG3000-980-130 | TECH 320B REAR HOUSING ASSEMBLY | 7.74 |
| | FG3000-980-131 | 3020B REAR HOUSING ASSEMBLY | 7.74 |
| 8 | FG3000-421-184 | BAIL - SERIES 300 | 1.20 |
| | FG3000-422-184 | BAIL - SERIES 3000 | 1.20 |
| | FG3000-423-184 | BAIL - HD SERIES | 1.85 |
| 9 | FG3000-450-152 | O-RING SCREW (HD SERIES ONLY) | .16 |
| 10 | FG3000-450-104 | SCREWS RECESSED PAN | .16 |
| 11 | FG3000-980-126 | BATTERY COVER ASSEMBLY - SERIES 300 | 2.00 |
| | FG3000-980-127 | BATTERY COVER ASSEMBLY - SERIES 3000 | 2.00 |

*Prices subject to change

## ELECTRONIC ASSEMBLY

| INDEX NO. | BECKMAN PART NO. | DESCRIPTION | SUGGESTED RETAIL |
|---|---|---|---|
| 1 | FG3000-390-100 | LIQUID CRYSTAL DISPLAY | 15.00 |
| 2 | FG3000-450-102 | SCREWS | .16 |
| 3 | FG3000-420-111 | CONNECTOR | 1.20 |
| 3-1 | FG3000-560-101 | HD-100 CONNECTOR KIT | 1.40 |
| 4 | FG3000-370-102 | CARBON ELASTOMER | 1.68 |
| 5 | FG3000-460-101 | BEEPER | 2.00 |
| 6 | FG3000-420-189 | CHIP CONNECTOR | 1.20 |
| 7* | FG3000-370-224 | GOLD ELASTOMERS (TWO) | 7.30 |
| 8 | FG3000-420-101 | CAM | 3.20 |
| 9 | FG3000-270-100 | MULTIPROCESSOR CHIP | 18.00 |
| 10 | FG3000-420-108 | CHIP RETAINER | 1.20 |
| 11 | FG3000-421-141 | RETAINER MOUNT (HD ONLY) | 1.10 |
| 11-1 | FG3000-420-141 | BURN BEEPER MOUNT (TECH 320B, 3020B ONLY) | .80 |
| 12 | FP260 | FUSE 600V/2A (4 IN A BOX) | 2.00 |
| 13 | FG3000-450-110 | SPRINT DETENT | .32 |
| 14 | FG3000-410-113 | LCD RETAINER KIT (SERIES 300) | 3.00 |
| | FG3000-410-114 | LCD RETAINER KIT (SERIES 3000) | 3.40 |
| | FG3000-560-100 | LCD RETAINER KIT (HD SERIES) | 3.40 |

*For older meters, when you order gold elastomers (FG3000-370-224), you should order also the chip connector (FG3000-420-189). You can order both in a kit: FG3000-600-204, $8.50.



INPUT BOARD

| SCHEMATIC LOCATION | REF | BECKMAN PART NO. | DESCRIPTION | QTY. | SUGGESTED RETAIL |
|---|---|---|---|---|---|
| B1,2,3 | U1 | FG3000-313-101 | ATTENUATOR | 1 | 21.00 |
| A1 | BR1 | FG3000-211-100 | BRIDGE | 1 | 3.76 |
| B4 | C1 | FG3000-131-205 | CAP. .047 | 1 | 2.00 |
| B4 | C2 | FG3000-191-100 | CAP TRIMMER | 1 | 5.60 |
| A4 | R1 | FG3000-31-202 | RES. 2K 1/2W | 1 | .84 |
| B1 | R2 | FG3000-51-106 | RES. WW 9 OHM | 1 | 1.84 |
| B2 | R3 | FG3000-71-101 | RES. WW .9 OHM | 1 | 3.44 |
| B2 | R4 | FG3000-71-100 | RES. WW .1 OHM | 1 | 3.44 |
| A5 | R17 | FG3000-31-241 | RES. 240 1/2W | 1 | .80 |
| B4 | R19 | FG3000-51-105 | RES. WW 19.8M OHM .1% | 1 | 9.90 |
| | CN1 | FG3000-370-146 | MALE CONNECTOR FLEX | 1 | 1.70 |
| A3 | RV1 | FG3000-80-102 | METAL OXIDE VARISTOR | 1 | 5.90 |
| A3 | VR4 | FG3000-231-101 | ZENER DIODE | 1 | 2.00 |
| | FC2 | FG3000-980-125 | FUSE CLIP ASSEMBLY | 1 | 5.00 |
| B2 | R4-1 | FG3000-71-104 | RES. WW .0898 OHM | 1 | 2.30 |
| | SB1 | FG3000-420-100 | SWITCH BLOCK | 1 | 9.60 |
| | FC1 | FG3000-370-107 | FUSE CLIP ASSEMBLY | 2 | .96 |
| A2 | R18 | FG3000-040-101 | SHUNT .01 OHM | 1 | 3.50 |
| A4 | R1-1 | FG3000-001-202 | RES. 2K 1/4W | 1 | .64 |

**FIGURE A**

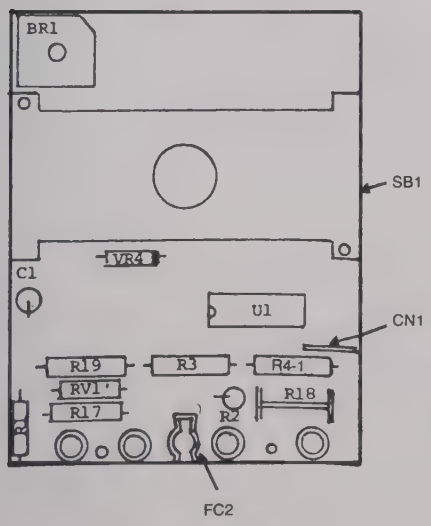
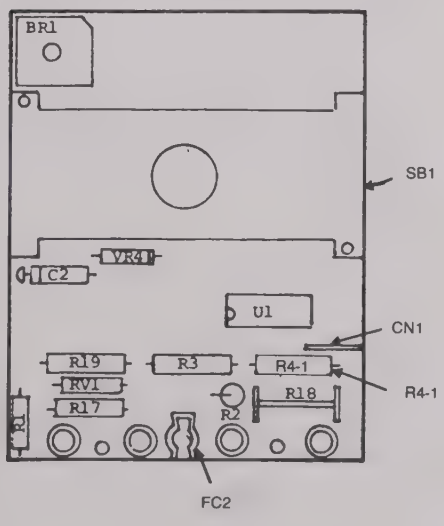
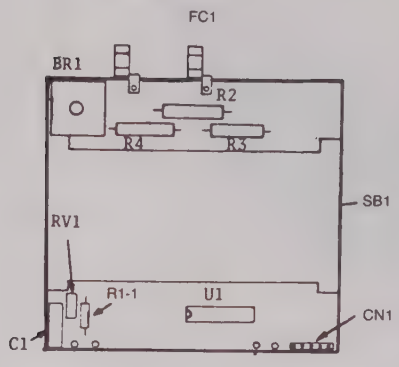



**FIGURE B**

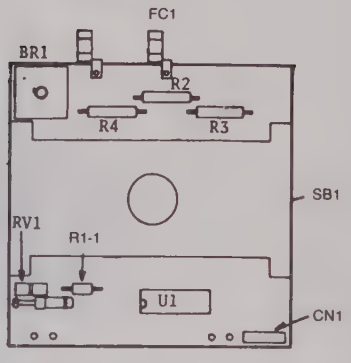


# INPUT BOARD

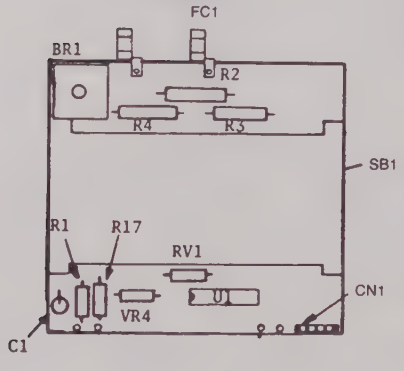
## FIGURE S



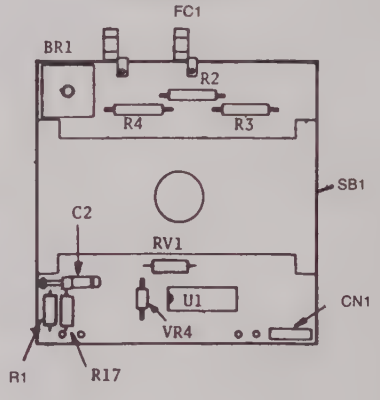

## FIGURE T



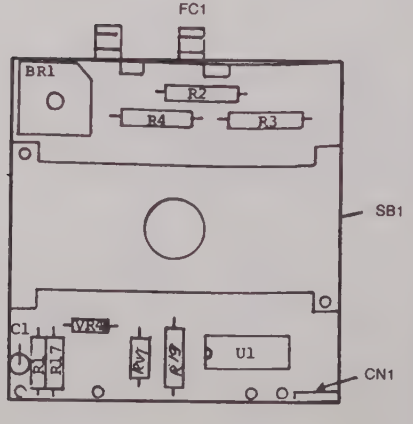

## FIGURE N



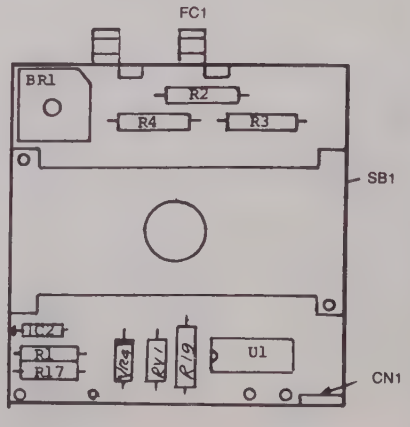

## FIGURE M




## FIGURE C



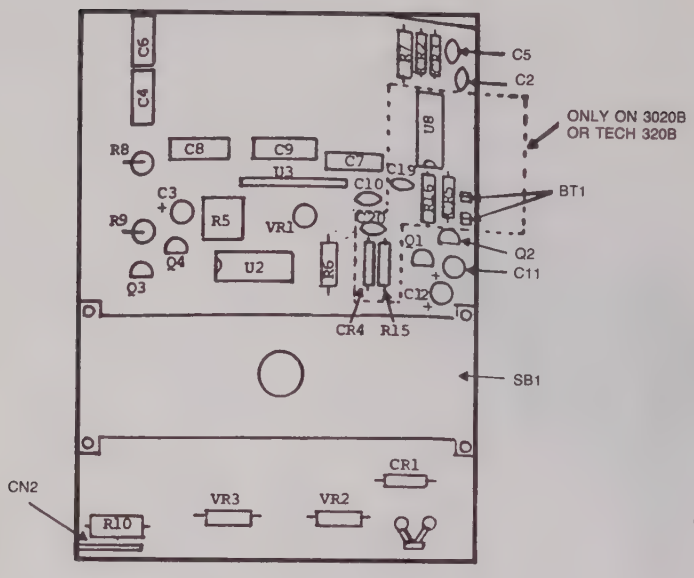

## FIGURE D



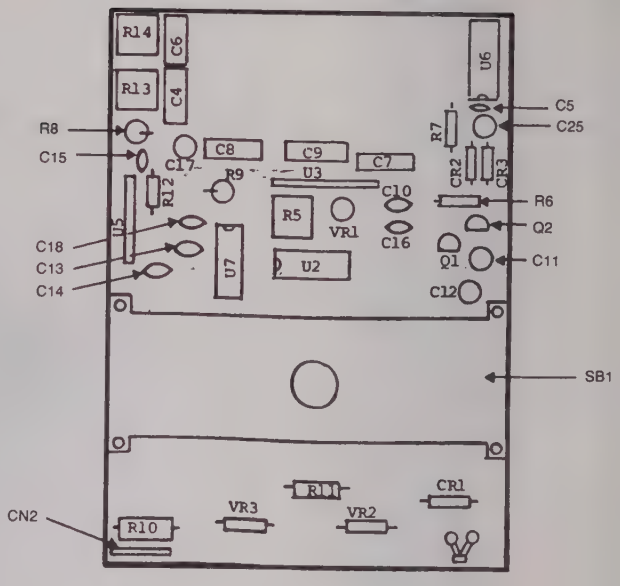
DISPLAY BOARD

| SCHEMATIC LOCATION | REF | BECKMAN PART NO. | DESCRIPTION | QTY. | SUGGESTED RETAIL |
|---|---|---|---|---|---|
| | SB1 | FG3000-420-100 | SWITCH BLOCK | 1 | 9.60 |
| G2 | U2 | FG3000-310-100 | REF.DIVIDER THIN FILM | 1 | 3.66 |
| F5 | U3 | FG3000-300-100 | RES.NETWORK,10 PIN SIP | 1 | 2.16 |
| F6 | U8 | FG3000-270-104 | IC CD 4030 | 1 | 1.76 |
| D3 | U5 | FG3000-300-102 | RES. NETWORK,8 PIN SIP | 1 | 1.80 |
| G4 | U6 | FG3000-270-102 | INT. CIR. HEX INV. 4069 | 1 | 1.92 |
| D3 | U7 | FG3000-270-101 | INT. CIR. RMS CONVERTER | 1 | 26.90 |
| D3 | Q3,4 | FG3000-251-100 | TRANS. PNP-G.P.-2N4126 | 2 | 1.30 |
| F5 | Q1 | FG3000-251-101 | TRANS. NPN G.P.-2N5088 | 1 | .84 |
| F5 | Q2 | FG3000-251-102 | TRANS. NPN, DARL.MPSA12 | 1 | .84 |
| I5,F4,G4 G6, F6 | CR1,2 CR3,4,5 | FG3000-201-100 | DIODE, SMALL SIGNAL | | .96 |
| C2,E5 | VR2,3 | FG3000-231-101 | DIODE,ZENER LOW LEAKAGE | 5 | 2.00 |
| F1 | VR1 | FG3000-231-102 | DIODE, REF. 1.2V | 2 | 3.54 |
| F6 | R16 | FG3000-1-474 | RES. 470 K OHM | 1 | .32 |
| E3 | R14 | FG3000-90-102 | RES. VAR. 500 OHM +10% | 1 | 2.00 |
| D3 | R13 | FG3000-90-103 | RES. VAR. 5 M OHM +20% | 1 | 2.00 |
| D3 | R12 | FG3000-1-120 | RES. 12 OHM +5%, 1/4W | 1 | .32 |
| D4 | R11 | FG3000-1-165 | RES. 1.6M OHM 5%,1/4W | 1 | .32 |
| F6 | R15 | FG3000-1-104 | RES. 100 K OHM, 1/4W | 1 | .80 |
| F5 | R6 | FG3000-1-241 | RES. 240 OHM, 1/4W | 1 | .80 |
| I1 | R7 | FG3000-1-474 | RES. 470 K OHM, 1/4W | 1 | .32 |
| C4 | R9 | FG3000-51-101 | RES. 200 K OHM, 3W | 1 | 1.30 |
| G3 | R8 | FG3000-51-102 | RES. 2 M OHM, 3W | 1 | 1.30 |
| E5 | R10 | FG3000-82-103 | RES. POS. TC,750 OHM | 1 | 3.76 |
| G2 | R5 | FG3000-90-101 | POTENTIOMETER, 10 K OHM | 1 | 2.00 |
| | BT1 | FG3000-370-176 | BEEPER TERMINAL | 1 | .60 |
| | CN2 | FG3000-370-144 | FEMALE CONNECTOR 5-PIN | 1 | .80 |
| H1,E3 G5 | C10,13 C16 | FG3000-101-100 | CAP. 470PF DISC CERAMIC | 3 | .48 |
| G4,G6 F6 | C2,5,19 C20 | FG3000-111-100 | CAP. .22 uF/25V MIN.CER. | 4 | 1.44 |
| G3,G1 | C8,9 | FG3000-130-102 | CAP. .22 uF,100V,MYLAR | 2 | 1.44 |
| G2 | C6 | FG3000-130-101 | CAP. .022 uF,250v,MYLAR | 1 | .72 |
| G3,G2 | C4,7 | FG3000-130-100 | CAP. .047 uF,250V,MYLAR | 2 | 1.10 |
| E3 | C12 | FG3000-151-100 | CAP. 3.3 uF,20v MIN TAN | 1 | 2.00 |
| D3,F3 | C3,25 | FG3000-151-101 | CAP. 10 uF/10V MIN,TAN | 2 | 2.08 |
| I5 | C11 | FG3000-161-100 | CAP. 10uF, ELECTROLYTIC | 1 | 1.10 |
| D3,E3 | C14,15 | FG3000-101-101 | CAP. 33pf,DISC CERAMIC | 1 | .72 |
| C3 | C18 | FG3000-101-102 | CAP. 4.7 pf DISC CERAMIC | 1 | .80 |
| C3 | C17 | FG3000-151-102 | CAP. 47 uf/6v MIN, TAN. | 1 | 3.40 |

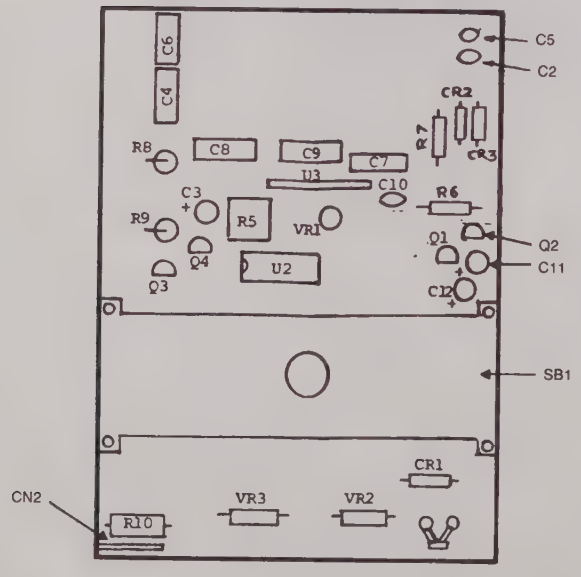
## FIGURE R&P
## DISPLAY BOARD—NON-RMS



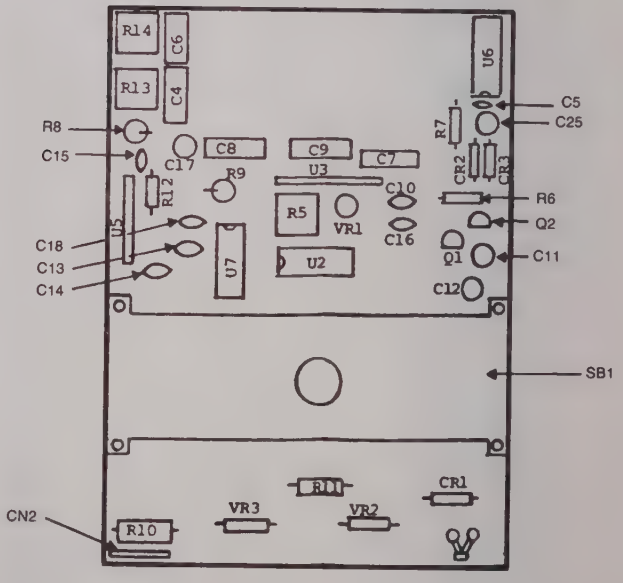

## FIGURE Z
## DISPLAY BOARD—RMS




## FIGURE W
## DISPLAY BOARD—NON-RMS




## FIGURE X
## DISPLAY BOARD—RMS



SECTION FOUR

## BECKMAN DIGITAL MULTIMETER SERVICE CENTERS--U.S./CANADA

Please note that all authorized service centers are NOT REQUIRED to abide by the factory flat fee policy. Please contact each center for estimates.

### CALIFORNIA - SO.

Metermaster
5646 Jillson Street
Los Angeles, CA 90040
(213) 685-4340

Shafer Engineering
333 North Santa Anita, #7
Arcadia, CA 91006
(213) 795-5000

### CALIFORNIA - NO.

Standard Meter Labs
11815 Dublin Boulevard
Dublin, CA 94566
(415) 828-4837

### COLORADO

Barnhill Associates
7076 South Alton Way, Building A
Englewood, CO 80112
(303) 779-3600

Instrument Repair Labs
1728 - 16th Street
Boulder, CO 80302
(303) 449-2721

D.H. Crump & Co.
6340 West Mississippi
Lakewood, CO 80226
(303) 936-4407

### GEORGIA

Process Measurement Company
4509 Fulton Industrial, S.W.
Atlanta, GA 30336
(404) 696-7481

### ILLINOIS

Metermaster
121 Gordon Street
Elk Grove Village, IL 60007
(312) 593-8650

### INDIANA

Electro-Lab Services, Inc.
1302 North Fulton Avenue
Evansville, IN 47712
(812) 423-5211

### LOUISIANA

Industrial Instrument Works, Inc.
5745 Salmen Avenue
Harahan, LA 70123
(504) 733-8355

### MARYLAND

EIL Instruments, Inc.
10 Loveton Circle
Sparks, MD 21152
(301) 771-4800

### MASSACHUSETTS

AST Servo Systems
20 Republic Road
North Billerica, MA 01862
(617) 667-8541

EIL Instruments, Inc.
21 "A" Street
Burlington, MA 01803
(617) 272-9450

### MINNESOTA

Instrumentation Services, Inc.
957 Winnetka Avenue North
Minneapolis, MN 55427
(612) 544-8916

MISSOURI

Industrial Service Laboratories Corp.
4354 Olive Street
St. Louis, MO 63108
(314) 535-5760

NEW YORK

Electronic Instrument Co.
85 Avenue E
Rochester, NY 14621
(716) 544-4392

Trott Electronics
9020 Wehrle Drive
Clarence, NY 14031
(716) 634-8500

The Instrument Mart
295 Community Drive
Great Neck, NY 11021
(516) 487-7430

NORTH CAROLINA

Metermetrics
5821 North Boulevard
Raleigh, NC 27604
(919) 872-5456

OHIO

Unitek Instruments
5919 Karl Road
Columbus, OH 43229
(614) 885-6703

OKLAHOMA

Central Instrument Labs
4673 South 83rd East Avenue
Tulsa, OK 74145
(918) 622-1140

OREGON

Westcon, Inc.
5101 North Interstate Avenue
Portland, OR 97217
(503) 283-0132

PENNSYLVANIA

Sunshine Scientific Instruments
1810 Grant Avenue
Philadelphia, PA 19115
(215) 673-5600

TEXAS

Dallas Meter-Tek Supply
10209 Plano Road
Dallas, TX 75238
(214) 349-6044

EIL Instruments, Inc.
7385 Ashcroft Street
Houston, TX 77081
(713) 271-3100

Metermaster
2809 National Drive
Garland, TX 75041
(214) 271-5671

Meters & Instruments Corporation
6428 Gulf Freeway
Houston, TX 70023
(713) 644-1631

VIRGINIA

Instrument Technical Reps
7400 Whitepine Road
Richmond, VA 23227
(804) 275-1431

WASHINGTON

EIL Instruments
1312 South 96th Street
Seattle, WA 98108
(206) 762-0880

# AUTHORIZED BECKMAN CANADIAN SERVICE CENTERS

For warranty and non-warranty repair service, please contact the following service centers.

BRITISH COLUMBIA

Master TV Services Ltd.
116 S.E. Marine Drive
Vancouver V6X 2S3
(604) 324-3633

MANITOBA

Probe Industrial Electronics
1874 Portage Avenue
Winnipeg, Manitoba R3J OH2
(204) 885-9320

ALBERTA

Kingsway Aviation & Industrial Instruments Ltd.
4238 - 91A Street
Edmonton T65 5V2
(403) 463-5264

ONTARIO

BCS Electronics
980 Alness Street, Unit 7
Downsview M3J 2S2
(416) 661-5585

QUEBEC

La Societe des Compteurs Projean Ltee
1332 Rue Belanger East
Montreal H2G 1A1
(514) 273-8331
TLX 05 829760

# DIGITAL MULTIMETERS
# SPARE PARTS ORDER FORM

**ALL ORDERS MUST BE PAID IN ADVANCE BY CHECK OR MONEY ORDER**

| PART NUMBER | DESCRIPTION | UNIT PRICE * | QUANTITY | CALIF TAX 6% | TOTAL |
|---|---|---|---|---|---|
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SHIP TO ADDRESS:
Please Print

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*Prices in U.S. Dollars

SUBTOTAL _____

SHIPPING 1.50 *

TOTAL _____

ALL MATERIAL WILL BE SHIPPED UPS
OR AIR PARCEL POST.

Send order and remittance to:

BECKMAN INSTRUMENTS
~~630 PUENTE ST.~~
~~BREA, CA 92621~~
ATTN: CUSTOMER SERVICE

~~(619) 495~~
~~213~~) 690-7255

www.manualsp
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